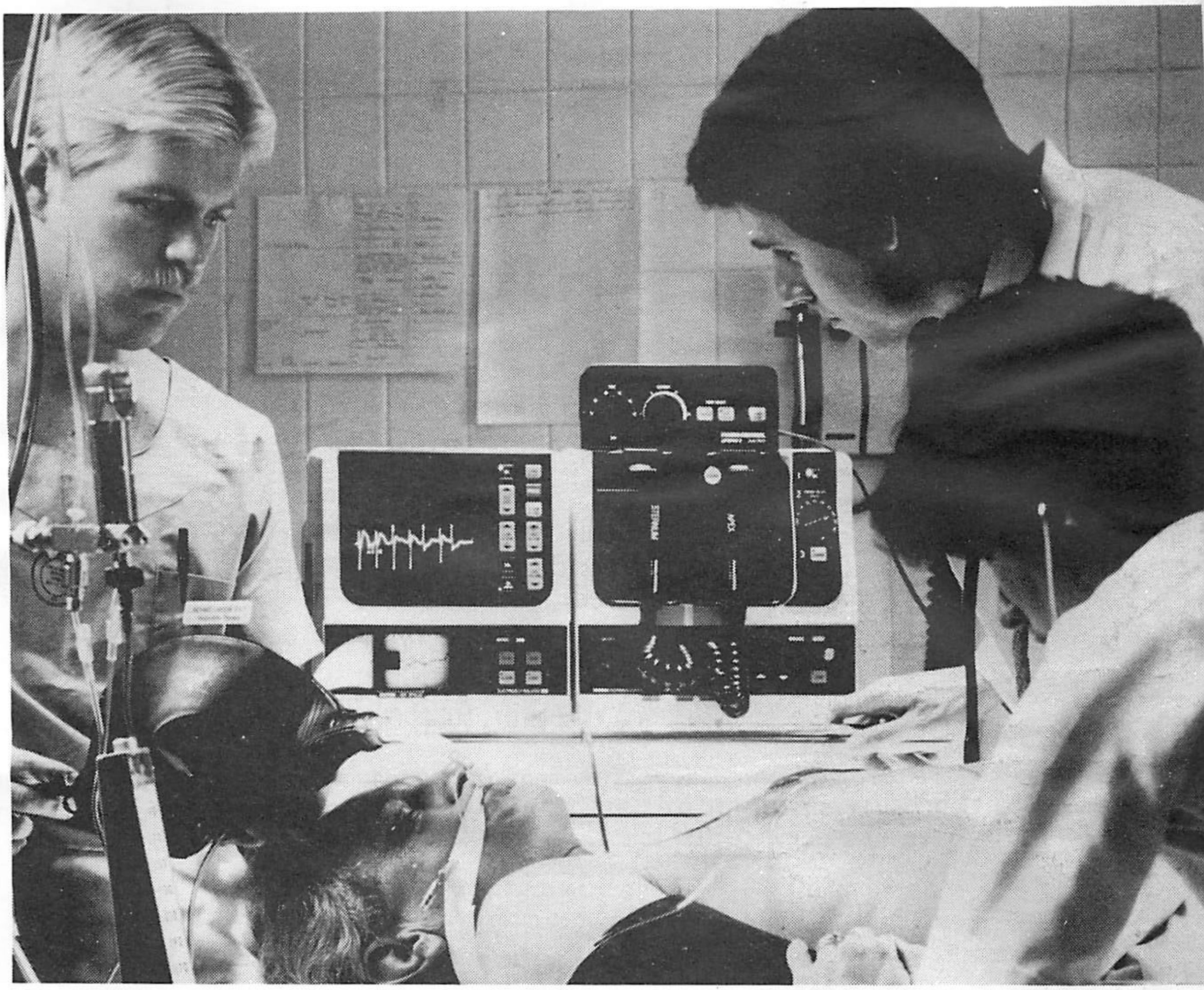

LIFEPAK® 8

Monitor/Defibrillator/Pacing Cassette

Operating and Service Manual

Manual No. 803195-05
December 1987

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WARRANTY POLICY (USA ONLY)

Refer to the product warranty statement included in the accessory kit shipped with the product. Duplicate copies may be obtained from the local Physio-Control Sales and Service Office.

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CONFIGURATION INFORMATION

This manual is current with the listed revision level of the following part numbers. The following part numbers appear in the same order as in Table 5-1.

DESCRIPTION	PART NUMBER	REV
MONITOR FINAL ASSEMBLY	802800-14 THRU -26	B
UPPER FRONT PANEL ASSEMBLY	802803-04 THRU -07	ORIG3
LOWER FRONT PANEL ASSEMBLY	802804-05 THRU -09	ORIG3
GENERIC MONITOR ASSEMBLY	802801-03	F8
REAR PANEL ASSEMBLY	802808-05	C1
RECORDER ASSEMBLY	802854-02	C
CHARGER PCB ASSEMBLY	802821-07	D5
POWER SUPPLY ASSEMBLY	802815-03	A4,B2
ECG PCB ASSEMBLY	802833-05	B4
CONTROL PCB ASSEMBLY	802827-04	ORIG9
GATEWAY PCB ASSEMBLY	802835-05	B
CRT PCB ASSEMBLY	802831-03	C5
ANODE SUPPLY PCB ASSEMBLY	802813-01	A
RECORDER PFC ASSEMBLY	802819-06	B1
UPPER SWITCH MODULE PCB ASSEMBLY	802845-01	ORIG3
LOWER SWITCH MODULE PCB ASSEMBLY	802844-04	A3
REAR PANEL PCB ASSEMBLY	802829-01	A4
MAIN PFC ASSEMBLY	802823-01	ORIG3
DEFIBRILLATOR FINAL ASSEMBLY	802700-07 THRU -16	B
UPPER FRONT PANEL ASSEMBLY	802707-05 THRU -08	ORIG2
LOWER FRONT PANEL ASSEMBLY	802702-05 THRU -08	ORIG3
GENERIC DEFIBRILLATOR ASSEMBLY	802701-03	B4
GENERIC APEX AND STERNUM PADDLE ASSEMBLIES	802901-04 AND -05	ORIG5
REAR PANEL ASSEMBLIES	802703-03	A1
POWER SUPPLY PCB ASSEMBLY	802719-06	B1
MAIN PCB ASSEMBLY	802715-03	A5
LOGIC PCB ASSEMBLY	802725-08	C7
OPTICAL INTERFACE PCB ASSEMBLY	802717-01	A
TEST LOAD PCB ASSEMBLY	802713-02	A
UPPER SWITCH MODULE PCB ASSEMBLY	802711-02	ORIG3
LOWER SWITCH MODULE PCB ASSEMBLY	802709-02	A
CASSETTE INTERFACE PCB ASSEMBLY	803569-01	A1
CONTROL PFC ASSEMBLY	802721-03	A1
PACING CASSETTE FINAL ASSEMBLY	802904-04	B4
PACING CASSETTE SWITCH DISPLAY PCB ASSEMBLY	802913-01	ORIG2
PACING CASSETTE PFC ASSEMBLY	802911-02	B2
DEFIBRILLATOR CASSETTE FINAL ASSEMBLY	802903-03	A4

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HOW TO USE THIS MANUAL

This manual is divided into 6 major sections in addition to the front matter. The front matter contains information about the current revision configurations, a Safety Summary and general operating cautions as well as the Table of Contents, List of Illustrations and List of Tables.

Section 1 of the LIFEPAK 8 manual provides the user with introductory information including General Specifications, PHYSICAL and FUNCTIONAL DESCRIPTIONs. This section also includes the THEORY OF OPERATION with detailed circuit descriptions.

Section 2 familiarizes the user with the operation of the equipment. It lists ACCESSORIES AND REPLACEMENT ITEMS, identifies CONTROLS AND INDICATORS, provides PERIODIC SERVICE PROCEDURES and gives OPERATOR MAINTENANCE instructions. This section is not intended to instruct the operator in the clinical use of the instrument; a separate OPERATING INSTRUCTIONS booklet is available for that purpose.

Section 3 contains a list of recommended TEST EQUIPMENT, explains the TEST SETUP, and provides procedures to perform FUNCTIONAL TEST AND CALIBRATION. Troubleshooting information is also included.

Section 4 provides general maintenance procedures for the LIFEPAK 8. Included are a list of TOOLS AND MATERIALS for cleaning and repair procedures. DISASSEMBLY PROCEDUREs are also included.

Section 5 contains ILLUSTRATED PARTS LISTS for mechanical assemblies; PARTS LISTS, COMPONENT LAYOUTS and SCHEMATIC DIAGRAMS are provided for Printed Circuit assemblies.

Section 6 consists of COMPONENT REFERENCE DIAGRAMS, which provide data for selected electronic components used in this instrument.

SAFETY INFORMATION

SAFETY SUMMARY

The general safety information in this summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS IN THIS MANUAL

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury.

TERMS AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS IN THIS MANUAL

⚠ ATTENTION	Identifies a Static Sensitive Device
*	Indicates that additional information about a device may be found in Section 6, Component Reference Diagrams.

SYMBOLS AS MARKED ON EQUIPMENT

The symbols below may be found on various configurations of the LIFEPAK 8 Monitor and Defibrillator.

⚡	DANGER--High voltage.
⏚	Protective ground (earth) terminal.
⚠	ATTENTION--refer to manual.
-|🚶|-	Defibrillation protected, type BF patient connection
-|♥|-	Defibrillation protected, type CF patient connection
○	Off (Power: disconnection from the mains)
|	On (Power: connection to the mains)
⊟	Fusible link
▽	Equipotentiality connector

MAKE PERIODIC SAFETY INSPECTIONS

Inspect the power cord periodically for fraying or other damage, and replace as needed. Do not operate the apparatus from mains power with a damaged power cord or plug.

Frequent electrical and visual checks should be made on cables and electrode wires. Broken or frayed electrode wires, or loose snap-fittings may cause interference or loss of signal. Particular attention should be paid to the point at which the wire enters the terminals, since flexure will eventually cause breakage of strands at this point.

POWER SOURCE

This product is intended to operate from a power source that does not apply more than 264V RMS (129V RMS in U.S.A. and Canada) between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation. If the integrity of the protective earth conductor of the ac mains power outlet is in doubt, the equipment shall be operated from the internal power source.

The product is compatible with isolated power systems as used in operating rooms.

USE THE PROPER POWER CORD

Use only the power cord and connector provided with your product. Use only a power cord that is in good condition.

This product requires a three-wire (18 gauge, SJT-grade) power cord which is supplied (in U.S.A. and Canada) with a three-terminal, polarized plug (Hospital Grade) for connection to the power source and protective ground. The ground (earth) terminal of the plug is directly connected to the frame of the product. For maximum electric shock protection, insert this plug only in a mating (Hospital Grade) power outlet with a protective ground contact. Do not bypass the grounding connection. Any interruption of the grounding connection could create an electric shock hazard.

USE THE PROPER FUSE

To reduce fire hazard, use only the fuse specified for your product, identical in type, voltage rating, and current rating. Fuse replacement instructions are in the Maintenance Section.

USE PROPER ELECTROSURGERY RETURN CIRCUIT

Reduce the likelihood of electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit. Many fully isolated electrosurgery units (ESUs) allow other return paths if improperly connected. Refer to the ESU operating instructions.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

Do not operate this product in the presence of flammable gasses or anesthetics. Explosion can result. Refer to safety documents NFPA 56A, Standards for the

Use of Inhalation Anesthetics, and NFPA 70, National Electrical Code (Health Care Facilities section), before operating this product in the proximity of flammable gases or anesthetics.

USE ONLY SAFE METHODS OF INTERCONNECTION

To protect against electrical shock from the product cabinet whenever auxiliary equipment is electrically connected to this product, proper grounding is essential. When this product is connected to other line-operated equipment, battery operation should be avoided. If it cannot be avoided, the product must be grounded using the terminal provided on the rear panel. It is extremely important that equipment interconnections be made in accordance with NFPA No. 70-1981, National Electrical Code, Article 517, Health Care Facilities. Compliance with paragraph 517-80 and 517-120 is especially important.

NOTE: Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, leakage current and grounding requirements must be maintained.

SERVICE

Component replacement and internal adjustments must be made by personnel qualified by appropriate training and/or experience.

DO NOT MOUNT PRODUCT DIRECTLY ABOVE PATIENT

Place the product in a location where it cannot harm the patient or others should it fall from its shelf or other mount.

USE ONLY RECOMMENDED ACCESSORIES

To promote patient safety, use only accessories recommended and/or provided by Physio-Control.

USE ONLY RECOMMENDED STERILIZATION METHODS

Do not autoclave this product.

Do not autoclave any Physio-Control defibrillator paddles. Many accessories can be severely damaged by autoclaving. Pediatric paddles and sterilizable paddles may be gas sterilized.

A product that has been dropped or severely abused should be checked by personnel, qualified by appropriate training and/or experience, to verify proper operation and acceptable leakage current values.

SECTION 1
DESCRIPTION

1-1. OVERVIEW

This section describes the general features and specifications and provides circuit descriptions for the LIFEPAK 8 Cardiac Monitor, Defibrillator, and Pacing Cassette. The section is divided into three parts: Physical Description provides a general description of the LIFEPAK 8 and lists specifications; Functional Description briefly describes the LIFEPAK 8 circuitry at a functional block level; Theory of Operation provides detailed circuit descriptions at the component level.

1-2. PHYSICAL DESCRIPTION

The LIFEPAK 8 is a modular system designed to be flexible and expandable. The Monitor may be used as part of the LIFEPAK 8 System or as a complete stand alone ECG monitor/recorder. The Monitor can interface with a central station or computer and can accept other Physio-Control monitoring modules and display their information. An internal battery assures that operation will be continuous, even in the event of an ac power failure. Recordings may be delayed, real time diagnostic, or automatic upon alarm. Because of a built-in 10 second delay, alarm recordings capture pre-alarm events.

The LIFEPAK 8 Defibrillator incorporates a synchronizer for cardioversion, special low energy selections for open heart or neonatal application, and the capability to accept and power an external transchest pacemaker "cassette." Another cassette allows the rapid use of disposable defibrillator paddles, anterior-posterior, and internal paddles while leaving the standard adult external paddles connected and ready for use. Pediatric paddles slip over the standard adult paddles. The Defibrillator module also has its own internal battery.

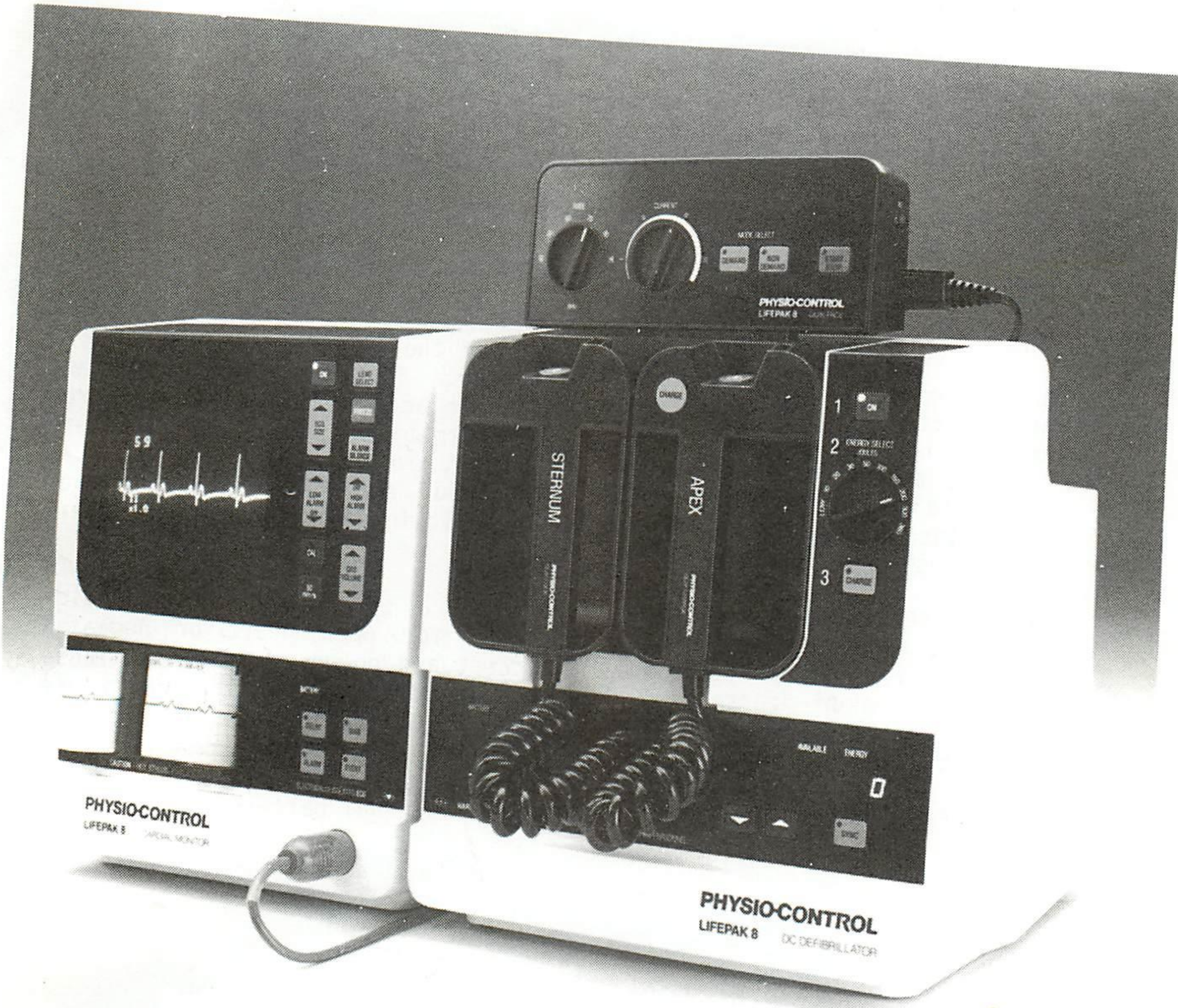
PHYSIO-CONTROL
LIFEPAK 8
STERNUM
APEX
CHARGE
1
2
3
0
PHYSIO-CONTROL
LIFEPAK 8
PHYSIO-CONTROL
LIFEPAK 8
DC DEFIBRILLATOR

FIGURE 1-1. LIFEPAK 8 MONITOR/DEFIBRILLATOR/PACING CASSETTE

TABLE 1-1

LIFEPAK 8 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATIONS
MONITOR	
● INPUT	Isolated ECG via Quik-Look Defibrillator paddles when ECG Monitor is connected to Defibrillator. Isolated ECG via 3, 4, or 5 lead patient cable, 6 pin patient cable connector.
● PATIENT CABLE LENGTH	4.0m (13 ft); cable 3.1m (10 ft), leads .9m (3 ft).
● COMMON MODE REJECTION	100dB minimum with respect to chassis ground with 51 kΩ imbalance at 60Hz. 65dB minimum with respect to isolated ground.
● CARDIOSCOPE DISPLAY	
Size	76mm (3 in) x 102mm (4 in).
Sweep Speed	25 ±1mm/s, 50 ±2mm/s
Frequency Response (-3dB)	1Hz to 30Hz.
● RECORDER DISPLAY	
Paper Size	50mm x 30m (100 ft).
Paper Speed	25 ±1mm/s or 50 ±2mm/s
Recorder Modes	Real time, or delayed by approximately 5 seconds.
Frequency Response	.05Hz to 100Hz (DIAG); .1Hz to 30Hz (DELAY).
Annotation	Includes time, date, recording mode, lead, gain, heart rate, defibrillation, and pacing parameters, and markers for alarm and event.
● HEART RATE METER	3 digit readout displays rates from 20 to 300BPM. ±3 BPM or ±4% whichever is greater.
● HEART RATE ALARMS	User selectable alarm limits. High 80-240BPM; Low 20-100BPM.
● ECG OUTPUT	1V/mV, .05Hz to 100Hz.
● FREEZE CONTROL	Momentary push button switch.

TABLE 1-1 (Continued)

LIFEPAK 8 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATIONS
● EVENT CONTROL	Momentary push button switch which causes Recorder to run 20 seconds with full annotation. If Recorder is running, will mark strip with annotation.
● CALIBRATION	Momentary push button switch simulates 1 millivolt signal to preamplifier.
● POWER SOURCE	
AC Input Options	Nominally 120Vac (90Vac minimum, 129Vac maximum) or 240Vac (198Vac minimum, 264Vac maximum), 50 or 60Hz.
Battery Type	Nickel-cadmium.
Battery Capacity	Typically 2.5 hours continuous cardioscope monitoring or 1 hour of continuous recording (or any linear combination) at 25°C with a heart rate of 60 and a 1.5cm cardioscope display.
● LOW BATTERY INDICATOR	Indicates low voltage level of Monitor battery.
● BATTERY CHARGING INDICATOR	Illuminates when battery is charging from line power.
● BATTERY INDICATOR	Illuminates when instrument is powered from battery.
● BATTERY CHARGE TIME	20 hours for depleted battery.
● SERVICE INDICATOR	Indicates continuous self-diagnostic routines have detected improper operation requiring service attention.
● MAXIMUM POWER CONSUMPTION	26 watts during cardioscope monitoring. 45 watts while recording.
● SIZE	26.7cm L x 24.1cm W x 28.6cm H (10.5 in x 9.5 in x 11.25 in).
● WEIGHT	7.5kg (16.6 lbs).
DEFIBRILLATOR	
● WAVEFORM	5 millisecond monophasic pulse (Edmark) per AAMI Standard.

TABLE 1-1 (Continued)

LIFEPAK 8 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATIONS
● OUTPUT ENERGY (Delivered)	External paddles: 1,2,3,4,5,6,7,8,9, 10,20,30,50,100,150,200,300,360 joules. Internal paddles: 1,2,3,4,5,6,7,8,9, 10,20,30,50 joules. Defibrillator output electrically isolated.
● TEST LOAD	Verifies energy delivery accuracy (±15%) and timing (within 30ms) at 100 and 360 joule settings.
● CHARGE CONTROL	Independent momentary push button controls on front panel and Apex paddle.
● CHARGE INDICATORS	Flashing lamps on paddle and front panel along with incrementing digital display indicate charge in progress. Upon full charge, AVAILABLE ENERGY message illuminates and a tone sounds. Three digit display shows energy available for discharge.
● CHARGE TIME	Charge to 360 joules in less than 10 seconds at 25°C when ac operated, or dc operated from a fully charged battery. Charge to 360 joules in less than 12 seconds when dc operated after 15 maximum energy discharges.
● OUTPUT PADDLE	
Electrode Area	82 cm².
Cord Length	3 m (10 ft).
Discharge Control	Discharge controls on both paddles in series.
● DEFIBRILLATOR SYNCHRONIZER	Synchronizes Defibrillator pulse to patient-generated R wave.
Sync Indicator	Marker on cardioscope display indicates sync detection.
Syncronized Discharge	Defibrillator will discharge within 30 ms after application of the sync pulse to the Defibrillator. (ANSI/AAMI DF2 1982 section 3.2.1.23).
Sensitivity Control	Monitor ECG SIZE control acts as threshold control.

TABLE 1-1 (Continued)

LIFEPAK 8 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATIONS
● BATTERY TYPE	Nickel-cadmium battery.
● BATTERY CAPACITY	Typically twenty-five (25) 360 joule discharges at 25°C. (Also applicable at 20°C.)
● LOW BATTERY INDICATOR	Indicates low voltage level of Defibrillator battery.
● BATTERY CHARGING INDICATOR	Illuminates when battery is charging.
● BATTERY CHARGE TIME	20 hours for depleted battery.
● SERVICE INDICATOR	Indicates continuous self-diagnostic routines have detected improper operation requiring service attention.
● AC INPUT OPTIONS	Nominally 120Vac (90Vac minimum, 129 Vac maximum) or 240Vac (198Vac minimum, 264Vac maximum), 50 or 60Hz.
● CASSETTE RECEPTACLE	Accepts cassettes which allow use of other paddles (internal or disposable) or pacing capability.
● MAXIMUM POWER CONSUMPTION	160 watts during Defibrillator charge. 25 watts on standby.
● SIZE	24.8 cm L x 26 cm W x 27.9 cm H (9.75 in x 10.25 in X 11 in)
● WEIGHT	8.91 kg (19.6 lbs)
ENVIRONMENTAL (Monitor/Defibrillator)	
● ATMOSPHERIC PRESSURE	500mmHg to 797mmHg (11,000 to -570 feet).
● RELATIVE HUMIDITY	0 to 95% (noncondensing) at 0-34°C. 0 to 80% (noncondensing) at 34-45°C.
● TEMPERATURE	0°C to 45°C operating, -30°C to 65°C storage
PACING CASSETTE	
● RATE RANGE	40 BPM to 90 BPM (+1%) in six discrete steps.

TABLE 1-1 (Continued)

LIFEPAK 8 GENERAL SPECIFICATIONS

CHARACTERISTIC	*QUANTITY OR SPECIFICATIONS
● RATE ACCURACY	±1% over entire range.
● OUTPUT	Monophasic, truncated, exponential current pulse with 15-25% decay.
● PEAK OUTPUT CURRENT	0-200mA ±15% (continuously adjustable) for loads between 0 and 500 ohms.
● OUTPUT PULSE DURATION	20 ±1ms.
● SENSITIVITY	Demand mode R wave detection supplied by Monitor. Demand and nondemand modes require use of Monitor.
● REFRACTORY PERIOD	340 ms ±10%.
● PACING ELECTRODES	QUIK-PACE self adhesive electrodes.
● WEIGHT	0.5 kg (1.1 lbs)
● LEAKAGE CURRENT	10μA source maximum, 20μA sink maximum.
● DEFIBRILLATION TOLERANCE	Will withstand a 400 joule discharge across pads shunted by 50 ohm load without damage to pacing electronics.
● POWER REQUIREMENTS	Supplied by Defibrillator.
● POWER CONSUMPTION	0.3 watts standby. 1.5 watts average pacing at 60 stimuli per minute, 500 ohm load.

*Specifications subject to change without notice. All specifications at 25°C unless otherwise stated.

1-3. FUNCTIONAL DESCRIPTION

The following paragraphs contain system data and brief descriptions of both Monitor and Defibrillator.

1-4. Monitor and Defibrillator System.

The LIFEPAK 8 Monitor and Defibrillator connect by a latching fin assembly or an accessory cable. Either method provides three optically isolated communication channels which carry Analog Data, Tri-State Control, and Defibrillator Serial Data. Each channel is multiplexed to conserve hardware. (See Figure 1-2.)

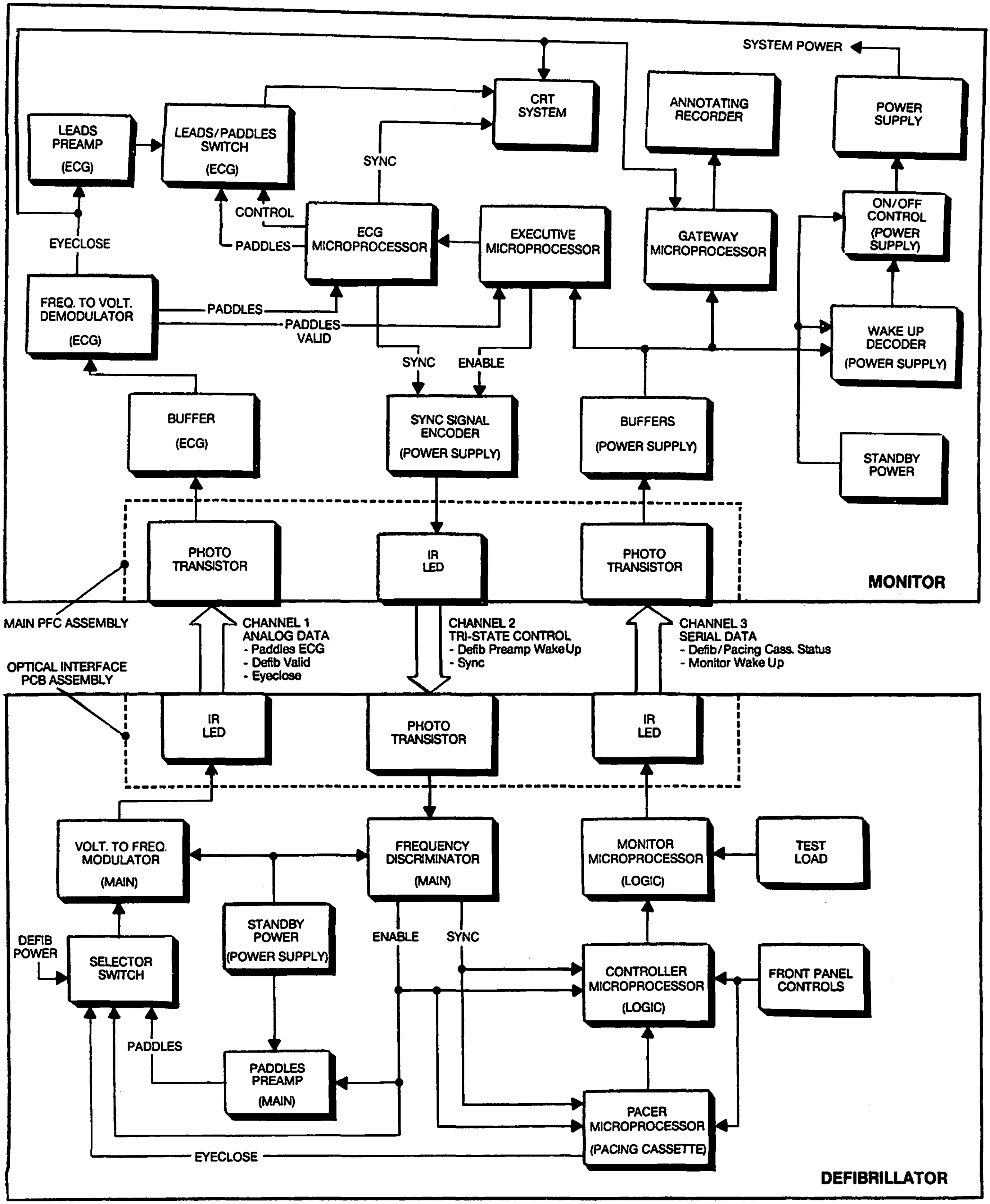
SYSTEM POWER
CRT SYSTEM
ANNOTATING RECORDER
POWER SUPPLY
LEADS PREAMP (ECG)
LEADS/PADDLES SWITCH (ECG)
SYNC
CONTROL
PADDLES
EYECLOSE
ECG MICROPROCESSOR
EXECUTIVE MICROPROCESSOR
GATEWAY MICROPROCESSOR
ON/OFF CONTROL (POWER SUPPLY)
FREQ. TO VOLT. DEMODULATOR (ECG)
PADDLES
PADDLES VALID
WAKE UP DECODER (POWER SUPPLY)
SYNC
ENABLE
BUFFER (ECG)
SYNC SIGNAL ENCODER (POWER SUPPLY)
BUFFERS (POWER SUPPLY)
STANDBY POWER
PHOTO TRANSISTOR
IR LED
PHOTO TRANSISTOR
MONITOR
MAIN PFC ASSEMBLY
CHANNEL 1 ANALOG DATA
- Paddles ECG
- Defib Valid
- Eyeclose
CHANNEL 2 TRI-STATE CONTROL
- Defib Preamp WakeUp
- Sync
CHANNEL 3 SERIAL DATA
- Defib/Pacing Cass. Status
- Monitor Wake Up
OPTICAL INTERFACE PCB ASSEMBLY
IR LED
PHOTO TRANSISTOR
IR LED
VOLT. TO FREQ. MODULATOR (MAIN)
FREQUENCY DISCRIMINATOR (MAIN)
MONITOR MICROPROCESSOR (LOGIC)
TEST LOAD
STANDBY POWER (POWER SUPPLY)
ENABLE
SYNC
DEFIB POWER
SELECTOR SWITCH
CONTROLLER MICROPROCESSOR (LOGIC)
FRONT PANEL CONTROLS
PADDLES
PADDLES PREAMP (MAIN)
PACER MICROPROCESSOR (PACING CASSETTE)
EYECLOSE
DEFIBRILLATOR

FIGURE 1-2. OPTICAL INTERFACE BLOCK DIAGRAM

The Monitor uses a Serial Data Bus for internal and external communication. Serial data is transmitted in packets containing from 7 to 32 bytes. Packets are separated by a null period during which the data bus remains high.

Some of these data packets circulate around an internal loop connecting the Monitor's three microprocessors. Refer to Figure 1-3. The Control PCB's Executive microprocessor generates packets at regular intervals. The ECG microprocessor receives this data, makes changes, and passes the packets on to the Gateway microprocessor. Again changes are made as data is updated. These modified packets return to the Executive microprocessor and the cycle begins again.

The Defibrillator also generates a data packet containing Pacing Cassette and Defibrillator status information and requests. This data is received by both Gateway and Executive microprocessors.

With the Monitor and Defibrillator connected, turning on the Defibrillator will automatically turn on the Monitor in PADDLES mode. (Note that a switch in the Monitor may be set so that LEAD II is always selected at power-on. Refer to paragraph 3-5 and Table 3-3). Monitor power is activated by a burst of serial data, containing the wake-up byte, transmitted across normally powered optical channel three. If the Monitor is already on, the wake-up byte is ignored.

When Defibrillator power is on, a serial data string is sent to the Monitor at .41 second intervals. The string contains discharge status, Pacing Cassette data, and failure codes. These packets of data are coded for annotation on the Recorder or CRT alphanumeric display.

Optical channel two is used to communicate cardioversion sync signals or QUIK-LOOK request to the Defibrillator. The Monitor then "watches" optical channel one for receipt of PADDLES/EYECLOSE carrier frequencies. Detection of these carriers establishes Defibrillator presence and allows entry to the desired mode of operation. QUIK-LOOK ECG is obtained from a switched off Defibrillator when the Monitor electronically turns the paddles preamplifier power on.

QUIK-PACE utilizes Monitor and Defibrillator resources to provide external transchest pacing impulses. All three optical channels support this function. Power and audible tones for QUIK-PACE are provided by the Defibrillator. Message printout and display, and R wave synchronization are Monitor functions.

LIFEPAK 8 system integrity is constantly tested by each of its six microprocessors. Tests include RAM, ROM, and software module check sums. Failure detection results in selective inhibition of system performance based on the nature of the problem. Any fault detection causes a SERVICE alert to be given.

Versatility of LIFEPAK 8 is significantly increased through use of two external interfaces. Both Monitor and Defibrillator function as hosts to two optional modules:

- QUIK-PACE - Noninvasive transchest Pacing Cassette

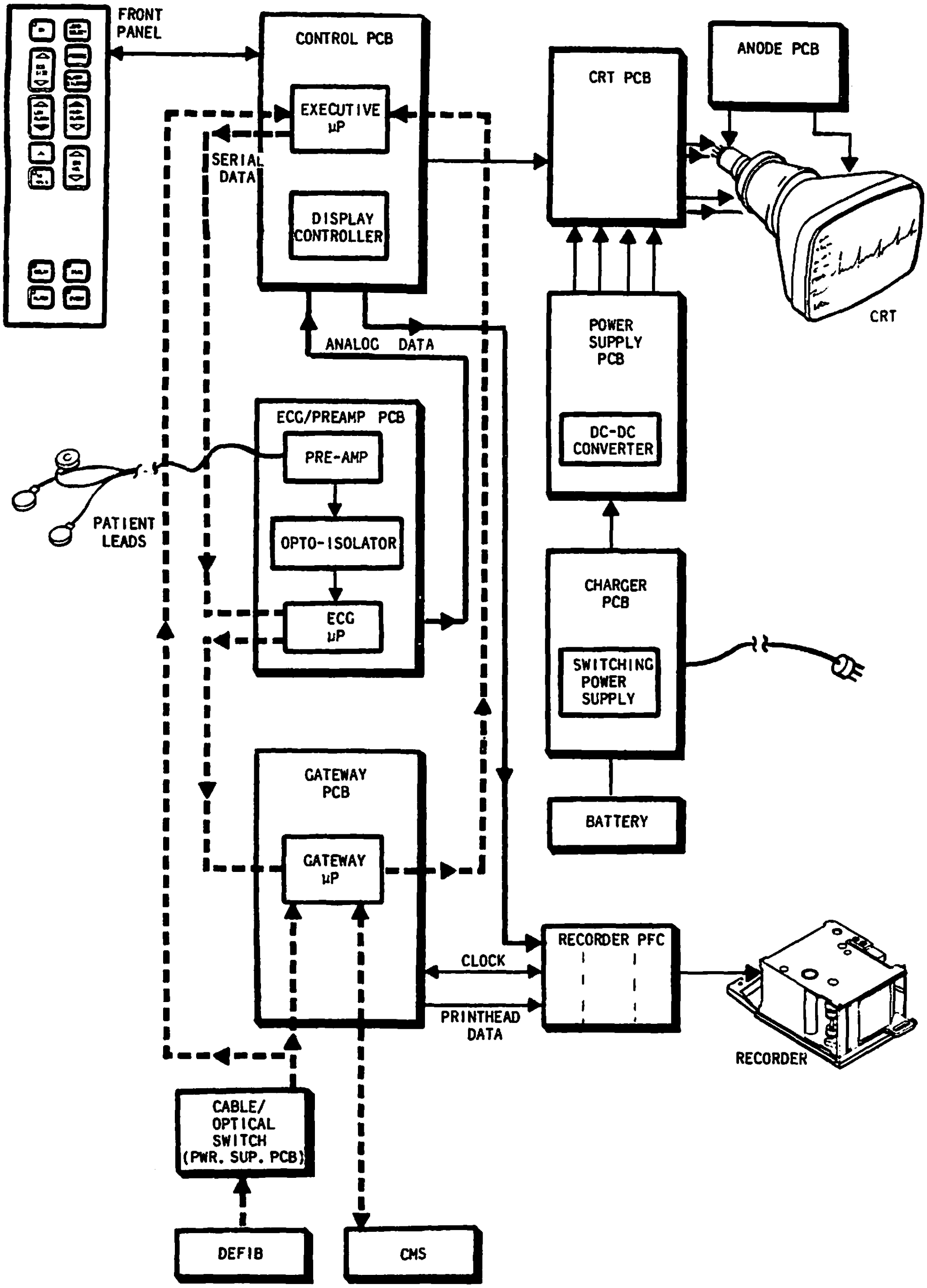
FRONT PANEL
CONTROL PCB
EXECUTIVE µP
SERIAL DATA
DISPLAY CONTROLLER
CRT PCB
ANODE PCB
CRT
ANALOG DATA
POWER SUPPLY PCB
DC-DC CONVERTER
ECG/PREAMP PCB
PRE-AMP
OPTO-ISOLATOR
ECG µP
PATIENT LEADS
CHARGER PCB
SWITCHING POWER SUPPLY
BATTERY
GATEWAY PCB
GATEWAY µP
RECORDER PFC
CLOCK
PRINTHEAD DATA
RECORDER
CABLE/ OPTICAL SWITCH (PWR. SUP. PCB)
DEFIB
CMS

FIGURE 1-3. LP 8 MONITOR BLOCK DIAGRAM

- Internal/disposable paddles Defibrillator Cassette

1-5. Monitor Performance.

The LIFEPAK 8 Monitor consists of a single trace cardioscope, dual speed alarm activated annotating recorder and digital heart rate meter with alarms. It features a hybrid display for alphanumeric information and analog signals. It is intended to be used for long-term, routine, and emergency monitoring. Monitor power may be obtained from the ac line or an internal, rechargeable nickel-cadmium battery pack. This battery pack is easily removed through the front panel.

When the Monitor is turned on, LEAD II is automatically selected except when the Monitor is connected to a powered-on Defibrillator as noted in paragraph 1-4. Patient ECG signals are displayed on a nonfade cardioscope which provides 5 seconds of information in 25mm/sec mode (2.5 seconds when 50mm/sec is selected); moving from right to left across the CRT with new data added at the right edge. An alphanumeric field presents heart rate, alarm settings, lead selected, gain, and various messages pertaining to system performance. Alphanumerics are arranged in either display fields; each six characters wide. All functions of the CRT are managed by the display controller (located on the Control PCB) which receives user commands from front panel touch keys through an Executive microprocessor.

Monitor operation is controlled by two push button panels that provide logic signals to the Control PCB's Executive microprocessor. Upper panel push buttons control ECG acquisition, alarms, and display functions; lower panel push buttons operate the annotating Recorder. Actuation of any button is accompanied by tactile feedback and an electronic audible click. Illuminated legends indicate battery status and need for service. Push button functions are defined in Table 2-1.

1-6. Defibrillator Performance.

The LIFEPAK 8 Defibrillator consists of a dc defibrillator with various paddle options, capability of synchronized cardioversion, and single joule resolution in the one to ten joule range. Control of Defibrillator operation is implemented in two microprocessors to enhance product reliability and failure mode definition.

Digital displays provide visual indications of available energy and energy delivered to an integral test load. Alerts are given to bring the user's attention to faults requiring service or to battery depletion. The Defibrillator may be operated in the stand alone mode; powered from ac line or an internal rechargeable nickel-cadmium battery pack. The battery pack is accessable through the Defibrillator front panel.

Several possible modes of Defibrillator operation are summarized below:

- DEFIB Mode - Ventricular defibrillation mode.

- FAILSAFE State - Charge oscillator, transfer relay, charge status indicator, and SYNC mode indicator are disabled; dump relay is closed.

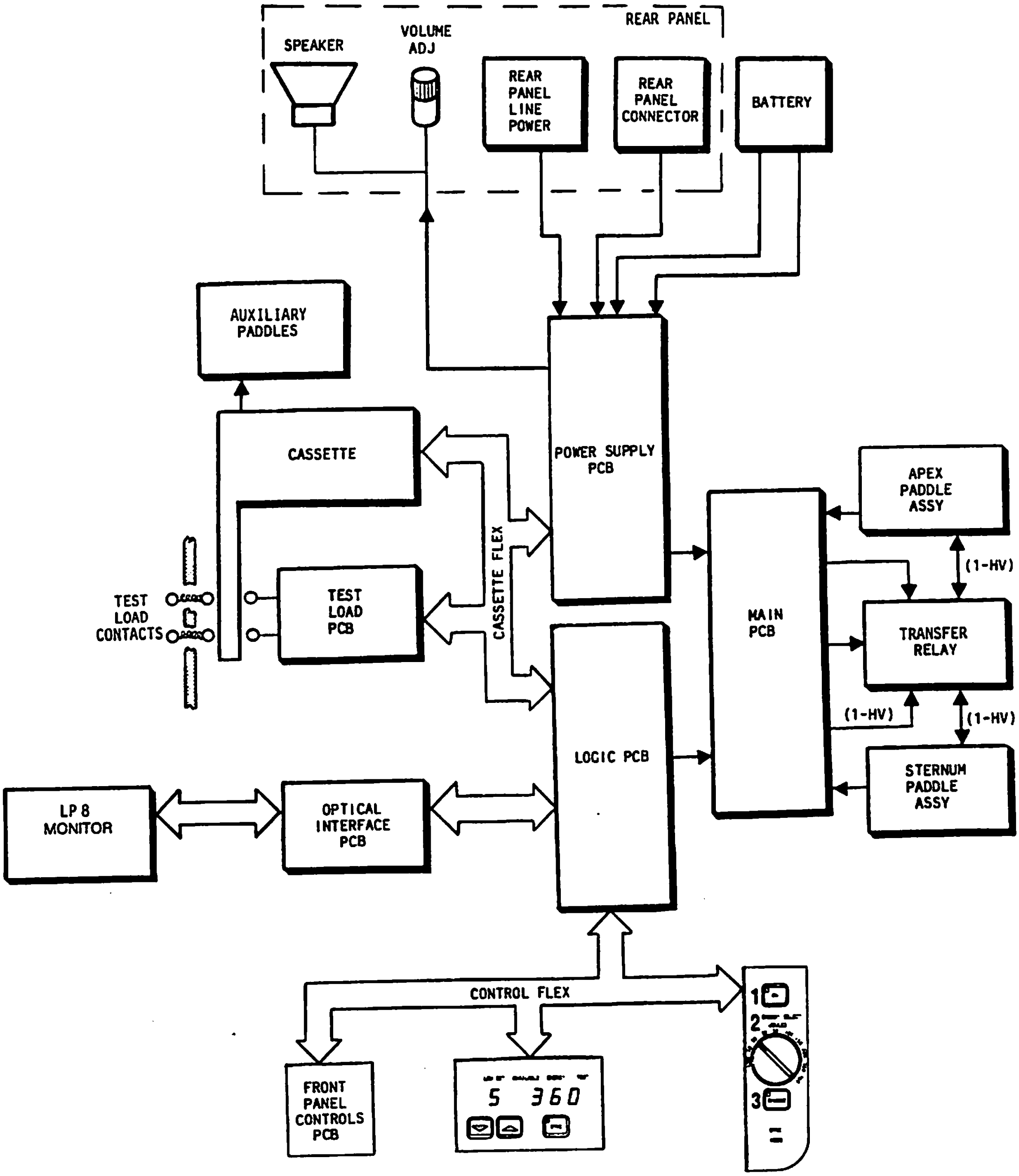
REAR PANEL
SPEAKER
VOLUME ADJ
REAR PANEL LINE POWER
REAR PANEL CONNECTOR
BATTERY
AUXILIARY PADDLES
CASSETTE
POWER SUPPLY PCB
CASSETTE FLEX
APEX PADDLE ASSY
MAIN PCB
(1-HV)
TEST LOAD CONTACTS
TEST LOAD PCB
TRANSFER RELAY
(1-HV)
(1-HV)
LOGIC PCB
STERNUM PADDLE ASSY
LP 8 MONITOR
OPTICAL INTERFACE PCB
CONTROL FLEX
FRONT PANEL CONTROLS PCB
5 360
1
2
3

FIGURE 1-4. DEFIBRILLATOR BLOCK DIAGRAM

- NOT READY State - Defibrillator has been charged for more than 60 seconds. Discharge is disabled and energy indicators are extinguished but energy on the Energy Storage Capacitor is not dumped. Depressing the CHARGE switch rapidly restores the READY state.
- READY State - Energy of the selected level is stored and ready for discharge.
- STANDBY/REDUCE CHARGE - Defibrillator is awaiting user commands, is not ready to transfer, and the dump relay is bleeding charge from the Energy Storage Capacitor.

Defibrillator operation is controlled by two push button panels; one of which has a rotary switch. These panels also carry circuitry used for display of energy information and status annunciators. Energy discharge is controlled solely by paddle discharge switches; charge may also be initiated by a paddle switch. The lower panel push buttons control low energy settings and sync mode selection. The upper panel push buttons are used for ON/OFF control, energy selection, and charge initiation. Actuation of any push button is accompanied by tactile feedback and an electronic audible click. Push button and indicator functions are outlined in Table 2-3.

Synchronized cardioversion can be selected. This feature uses the patient's monitored ECG signal (R wave) to trigger the Defibrillator discharge. The LIFEPAK 8 Monitor must be connected to the LIFEPAK 8 Defibrillator to use this feature. The synchronized discharge is used to correct atrial fibrillation, atrial flutter, or other arrhythmias. Figure 1-5 shows how, by using the R wave as the triggering signal, the defibrillating energy pulse is delivered at the proper time. This avoids the undesireable T wave portion of the ECG signal where electrical shock may cause ventricular fibrillation.

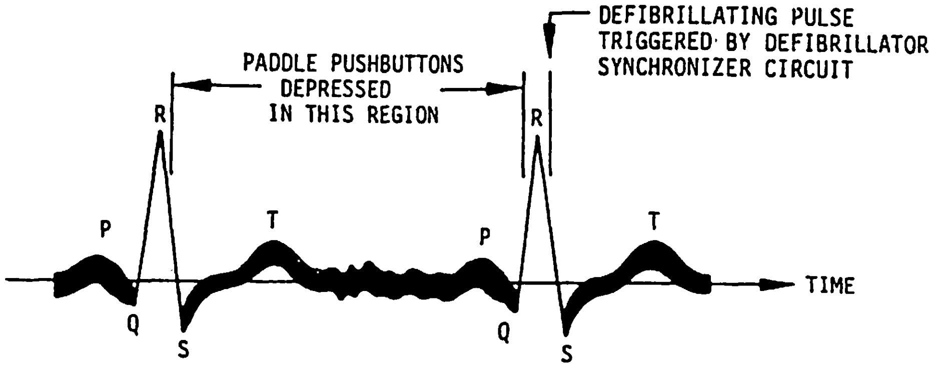

FIGURE 1-5. TYPICAL ECG WAVE FORM

1-7. THEORY OF OPERATION

Block diagrams in Figures 1-3, 1-4 and 1-23 provide an overall view of the system operation of the LP8 Monitor, Defibrillator, and Pacing Cassette as well as the operation of individual printed circuit boards. Schematic diagrams of these PCBs appear in Section 5. Refer to the schematics while reading the following circuit descriptions. Section 6 contains additional information about selected ICs (indicated by a * on the schematic) to aid in circuit analysis and troubleshooting.

> **NOTE:** There may be more than one configuration of a printed circuit board described in this section. All PCB descriptive headings are followed by an identifying part number which also appears on the PCB assembly as well as on the schematics, layout diagrams, and parts lists.

1-8. LP 8 MONITOR

Paragraphs 1-9 through 1-88 provide circuit descriptions for the Charger, Power Supply, ECG Preamp, Control, Gateway, CRT, and Anode Supply PCB Assemblies and the Recorder PFC Assembly.

The Monitor Interconnect Diagram (Figure 5-8) provides interconnection data for all the subassemblies.

1-9. CHARGER PCB ASSEMBLY (802821).

The Monitor Charger PCB (see Figures 1-6 and 5-9) functions as a switching power supply to maintain line isolation. After rectification and filtering, dc voltages are supplied for Monitor operation and battery charge current. The Monitor will function even with variations in the line voltage from 90V to 127V RMS (domestic units) or from 180V to 264V RMS (international units). Regulation of the Monitor's power supply voltages is achieved by pulse width modulation; the longer the pulse width from the power supply to the transformer, the higher the current output for a given voltage. The Charger PCB also controls relay switching (required for battery operation), and provides charge and battery operation annunciator drive signals.

1-10. AC Line Conditioning. AC line conditioning circuitry rectifies and filters line voltage. Voltage is split between C1 and C2, allowing the circuit to operate as a voltage doubler. When a switch from pin 5 to pin 7 of J1 is open, peak-to-peak line voltage is effectively applied across both C1 and C2 for operation on 220V line. When this switch is closed, peak-to-peak line voltage is applied across C1 alone during the positive phase, and across C2 alone during the negative phase; doubling the voltage for operation on 110V line.

C20 and VR1 prevent damage from high voltage spikes. A very high voltage surge will also cause VR1 to conduct so that F1 opens before the voltage on C1 and C2 increases greatly. L6 reduces susceptibility to common mode voltage spikes by presenting a high inductance to common mode currents. RT1 protects CR1 by limiting inrush current. Following inrush, a steady current drops the resistance of RT1 from about 5 ohms to less than 1 ohm. VR2 protects against voltage surges which might cause a dangerously high voltage across C1 and C2 while operating in the voltage doubler mode (VR1 is less effective against surges then). R1 and R2 are used to keep the voltages across C1 and C2 roughly equal despite differences in capacitor leakage.

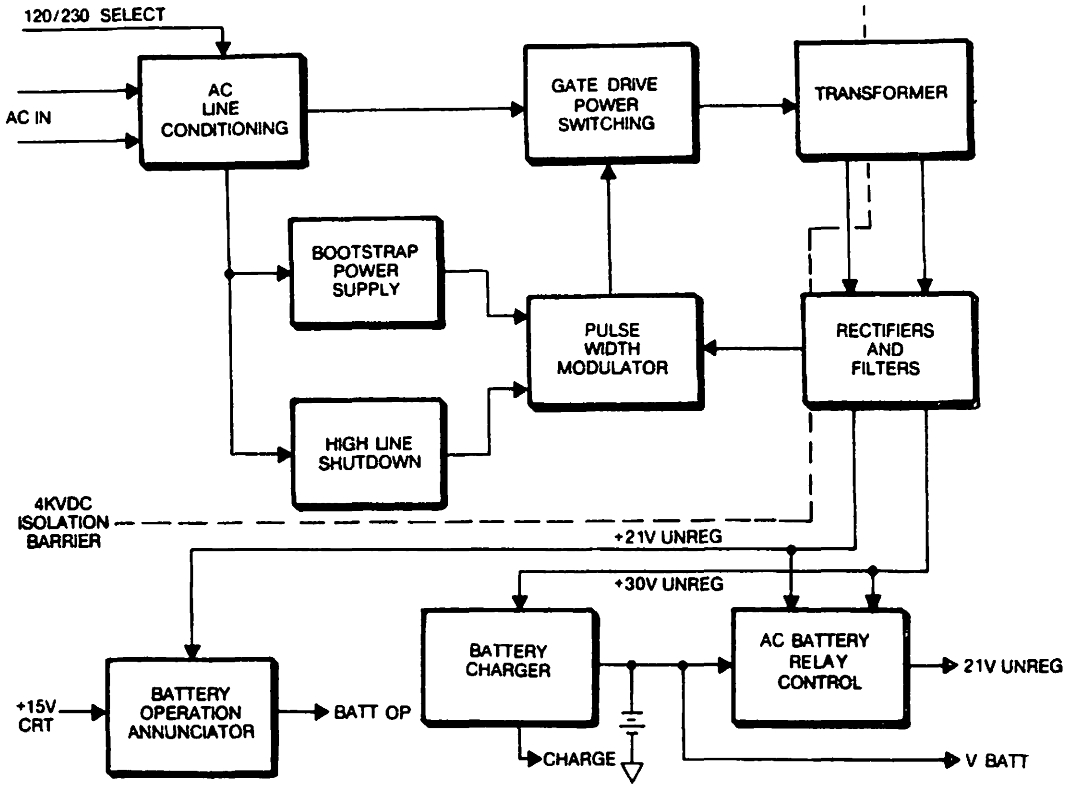
120/230 SELECT
AC IN
AC LINE CONDITIONING
GATE DRIVE POWER SWITCHING
TRANSFORMER
BOOTSTRAP POWER SUPPLY
PULSE WIDTH MODULATOR
RECTIFIERS AND FILTERS
HIGH LINE SHUTDOWN
4KVDC ISOLATION BARRIER
+21V UNREG
+30V UNREG
BATTERY CHARGER
AC BATTERY RELAY CONTROL
21V UNREG
+15V CRT
BATTERY OPERATION ANNUNCIATOR
BATT OP
CHARGE
V BATT

FIGURE 1-6. MONITOR CHARGER PCB BLOCK DIAGRAM

1-11. Bootstrap Power Supply. During normal operation, T1 provides power to U1 through L3. However, during start-up, before U1 begins regulating the power supply, another source of power is required. For this brief period, C5 is charged through R6 and R7 to a voltage of about +13V. At this point CR6 conducts enough to turn on Q3. As Q3 turns on Q4, Q3 latches on. CR7 conducts in the reverse direction to charge C6 and power U1 (CR7's zener voltage ensures that Q4 is turned on even when C6 is fully discharged). The bootstrap is successful when U1 remains on, due to the charge across C5, long enough for power to begin to flow through L3 back to transformer T1. The high voltage at C6 maintains a forward bias across CR7 and keeps Q4 and Q3 turned on. This prevents any bootstrap pulses after successful start-up has occurred. If the bootstrap is unsuccessful (for example during very low line voltage) then C5 discharges to 3.5-4V. Q4 then turns off, turning off Q3, allowing C5 to recharge and repeat the cycle.

1-12. Pulse Width Modulator. U1 is a pulse width modulator used to regulate the supply voltage. The operating frequency is set by R15 and C8, while the minimum dead time is set by R16. U1 generates an error signal, compares it with the ramp voltage across C8, and determines the duty cycle for pulse width modulation. One input of the error amp, pin 2 of U1, is connected to the +5.1V reference voltage. The other input, pin 1, is connected to a regulated +12.4V determined by a voltage divider consisting of R13 and R14. C9, C10, and R17 are feedback elements required for system stability. The outputs of U1, pins 11 and 14, normally present a low impedance to ground, however, during a pulse, one output (alternating with the other output) is driven high. R12 is in series with the U1 output stage to provide current limiting for U1 protection. C11 provides soft start operation, which causes the pulse widths to slowly increase from zero to the regulated pulse width. This prevents potentially damaging high currents in Q1, Q2, and the output rectifiers during startup. The modulator output pulse width is limited by the voltage stored on C11 which is slowly charged by a constant current source within U1. Note that a slower soft start means that the bootstrap circuit must power U1 for a longer period of time.

1-13. Gate Drive/Power Switching. Two switching FETs, Q1 and Q2, are used in this half-bridge supply. Since a 300V difference in source voltages can exist, T2 is required to couple the gates to U1, maintaining isolation. Between pulses, T2 reflects a low impedance from gate to source for both Q1 and Q2 keeping them off. For any given pulse, a positive voltage is applied gate to source for one FET, and a negative voltage is applied to the other due to the winding polarities of T2. Gate drive signals are prevented from exceeding the 20V gate to source maximum rating of the FETs by CR2 or through CR5. R3 and R4 control the speed of turn off and turn on, which reduces ringing, preventing unwanted very high frequency oscillation of Q1 and Q2. C3 provides a high frequency current return path to the storage capacitors C1 and C2, which ensures that the dc current through the transformer is always zero. C4 and R5 reduce the amplitude and duration of leakage inductance caused ringing which might otherwise damage Q1 or Q2. F2 is used to protect T1.

1-14. Rectifiers/Filters. This circuitry provides rectification, filtering, and voltage limiting. Resistors R24 and R25 are also used for current limiting in the event of a fault affecting the normally very low current sense output. The inductors L3, L4, and L5 are used not only for filtering but for regulation as well. These inductors average the output pulses to derive a pulse width dependent voltage. When there is no appreciable load however (such as when the Monitor is turned off) the inductors lose their regulating effect, and the filtered voltage can rise to nearly equal the transformer output. However, CR23 and CR24 prevent the +21V and +30V lines from rising above +25V and +39V, respectively. C12 and R20 provide additional protection of CR15 and the switching transistors.

1-15. High Line Shutdown. During line voltage surges, the rectified line voltage may rise to levels dangerous to Q1 and Q2, but not high enough to cause either varistor to conduct and open F1. To increase their resistance to these line voltage surges, Q1 and Q2 are kept off by the high line shutdown circuit. CR8 and CR9 are 200V zener diodes. If the rectified line voltage rises to approximately 7 volts above the combined CR8 and CR9 voltages, enough current flows into U1, pin 10, to cause U1 to automatically shut down. CR10 protects the input voltage at U1, pin 10, preventing it from exceeding a safe level.

1-16. Battery Charger. U5 is an adjustable output voltage regulator configured as a current source to charge the Monitor battery pack. It operates by maintaining a 1.2 to 1.3V drop between the sense pin and the output pin. The current through R36 which charges the battery must then be 132mA to 143mA. Q8 uses the same 1.2 to 1.3V supply from U5, together with R40 to produce a 18.5mA to 22mA current source only when charger current is flowing. This provides drive current for the front panel CHARGE LED.

1-17. AC/Battery Relay Control. The relay control circuitry has a number of functions. It drives the relay coil with a constant current even though the supply voltage may range from +16 to +25V. It turns on the relay with initial full voltage to the relay coil. It immediately turns off the current to the coil when the +21V supply voltage drops below +16V (to allow battery operation to begin before the power supply shuts down). Finally, it prevents the relay drive from turning on again until the supply voltage rises back up to approximately +21V.

The relay control circuit drives the relay coil with a constant current source comprised of U6A, U6D, R21, and R39. Current is set at 11.3mA by the base-emitter drop across U6D through R39. U6B, with C16 and R26, disables the current limiting, allowing full voltage across the relay coil for the first 10 to 20ms. Q5 will not turn on and cause the relay to open, until CR17 and CR19 conduct (so +21V must exceed +20.1V plus the base-emitter drop across Q5). However, when Q5 turns on, which turns U6C on and shorts out CR17, so that the +21V supply must fall to below +15V plus a base-emitter junction drop before Q5 will shut off allowing the relay to close and operate the instrument on battery power. CR18 is included for protection.

1-18. Battery Operation Indicator (LED Drive). This circuit supplies a constant current to the front panel BATTERY LEDs whenever the Monitor is on and operating on battery power. Q9 turns on when +15V CRT is present (Monitor on) and +21V is not present (line power not connected) so that Q9 gets its base drive from R41. When Q9 turns on, it draws about 20mA and the voltage drop across R42 turns on Q10. Q10 then starts to deplete the base of Q9, thus limiting the current through Q9. When operating from line power, +21V is present and reverse biases CR27. The base drive to Q9 is shut off, and no LED current flows. The same LEDs are used to indicate battery operation and are lit when the Monitor batteries are charging. CR22 prevents reverse current flow between the LEDs which illuminate BATTERY and the two LEDs which illuminate CHARGE.

1-19. POWER SUPPLY PCB ASSEMBLY (802815).

The Monitor Power Supply PCB (see Figures 1-7 and 5-10) consists of three functional sections each of which appear on a separate sheet of Figure 5-10. Sheet two, the main power supply, provides nine different regulated supplies (six different voltages) all derived from +21V UNREG (from the Charger PCB, Figure 5-9) by means of a flyback converter; sheet three consists of Defibrillator interface circuitry used for the serial data and sync channels; and sheet four consists of voltage monitoring, a microprocessor watchdog, and an audio amplifier.

1-20. Battery Protection/Reference Voltage. Power to this assembly is supplied by +21V UNREG. The voltage range on line power is from +16V to +26V. When the instrument is operating on batteries its range is from 0V to about +24V. Q1 and CR1 shut off battery current when battery voltage drops below approximately +13V to protect the nicad batteries from excessive draining. When the battery output voltage is above +13V, Q1 provides power to regulator U5 which then outputs the +5V UNSW. +5 UNSW is used to power the low power ON/OFF and WAKEUP circuitry, and to supply a reference voltage.

STDBY POWER is used to drive the real time clock on the Recorder PFC. When +21V UNREG is too low and Q1 is off, Q2 looks like a low leakage diode, allowing a lithium battery on the Recorder PFC to supply STDBY POWER without having current flow into the +5 UNSW supply. When the +21V UNREG line is above +13V, Q2 allows +4.3V to be supplied for STDBY POWER, saving the lithium battery. When the power supply is turned on, Q2 is turned on allowing the full +5V UNSW to be supplied for STDBY POWER, and permitting proper interfacing of the real time clock with other powered up circuits.

1-21. On/Off Control. Flip-Flop U2B determines the on/off state of the power supply. The $\overline{\text{ON/OFF}}$ input is from the ON front panel key which when pressed, switches this line to ground. U1A through U1C debounce this signal so only one toggling of U2B can occur every 100ms. When U2, pin 13, goes high, Q5 is turned on. This supplies power, VSW, to enable operation of the transformer drive circuitry, turning on the supply as well as other circuits. U1D, and timing circuit R5 and C2, insures that the power supply will initially be off when +21V UNREG is rapidly brought up.

1-22. Low Battery Detection. The battery voltage monitoring circuitry is used to warn of impending battery depletion, or to protect the battery by shutting off the Monitor. Q4 insures that this circuitry uses battery power only when the power supply is on. CR21 insures that a low battery voltage is disregarded as long as the +21V UNREG is a higher voltage than the VBATT line, indicating the Monitor is running on ac line power. Resistors RN6, R23 and R24 divide VBATT for comparison with +5V UNSW. LOW BATT is generated at U3C, pin 14, when VBATT is less than 17.7V. U4A uses this divider reference to detect when VBATT is less than 15.1V, at which time it resets U2B, turning off the Monitor. R26, C9, U1E, and U1F prevent the Monitor from being turned off until U4A has sensed a low battery condition for at least .5 seconds.

1-23. Transformer Output Rectifiers and Filters. Transformer T1 drives a variable frequency flyback converter. When current flows in the primary winding, the secondary rectifiers are reverse biased and no secondary current flows. This primary current is then shut off and the flux that has built up in the core induces a corresponding current in the secondary windings and in the now forward biased rectifiers. A triangular current pulse is delivered through diode rectifiers CR13, CR15 through CR20, to the output filter capacitors C18 through C25. The longer that voltage is applied to the primary, the higher the peak primary current will be, and the greater the energy transferred during each cycle. Using various taps of the secondary winding produces the different voltages needed.

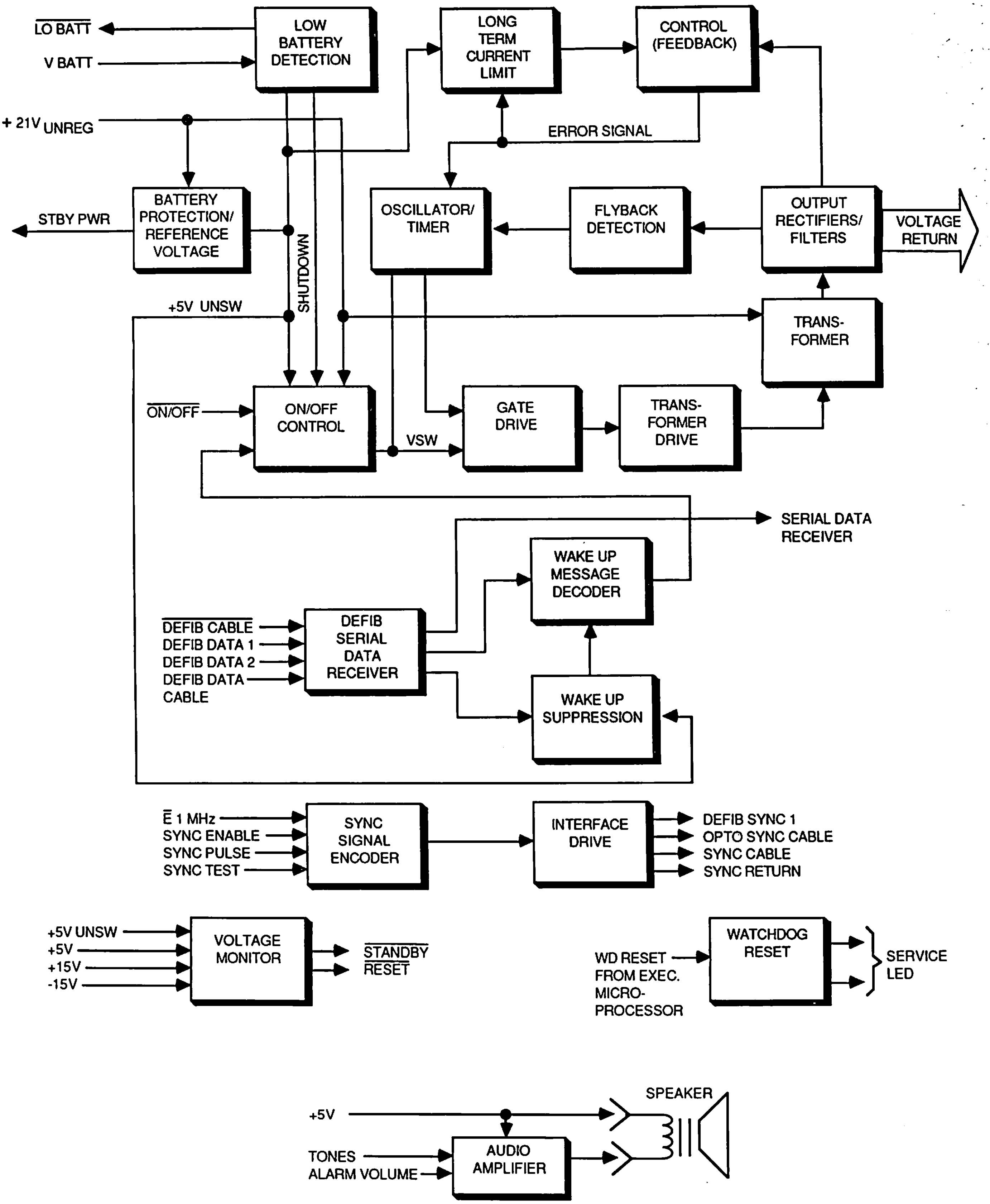
LO BATT
V BATT
LOW BATTERY DETECTION
LONG TERM CURRENT LIMIT
CONTROL (FEEDBACK)
+ 21V UNREG
ERROR SIGNAL
BATTERY PROTECTION/ REFERENCE VOLTAGE
STBY PWR
OSCILLATOR/ TIMER
FLYBACK DETECTION
OUTPUT RECTIFIERS/ FILTERS
VOLTAGE RETURN
SHUTDOWN
+5V UNSW
TRANS-FORMER
ON/OFF
ON/OFF CONTROL
VSW
GATE DRIVE
TRANS-FORMER DRIVE
SERIAL DATA RECEIVER
WAKE UP MESSAGE DECODER
DEFIB CABLE
DEFIB DATA 1
DEFIB DATA 2
DEFIB DATA CABLE
DEFIB SERIAL DATA RECEIVER
WAKE UP SUPPRESSION
E 1 MHz
SYNC ENABLE
SYNC PULSE
SYNC TEST
SYNC SIGNAL ENCODER
INTERFACE DRIVE
DEFIB SYNC 1
OPTO SYNC CABLE
SYNC CABLE
SYNC RETURN
+5V UNSW
+5V
+15V
-15V
VOLTAGE MONITOR
STANDBY
RESET
WD RESET FROM EXEC. MICRO-PROCESSOR
WATCHDOG RESET
SERVICE LED
SPEAKER
+5V
TONES
ALARM VOLUME
AUDIO AMPLIFIER

FIGURE 1-7. MONITOR POWER SUPPLY PCB BLOCK DIAGRAM

1-24. Transformer Drive. Q10 and Q11 are used to switch current in the primary on and off. When the transistors are turned on, primary current ramps up from zero to a current (up to 20 amps) determined by the on time. When Q10 and Q11 are shut off, a small leakage inductance in the transformer tries to keep current flowing through Q10 to Q11, instead of transferring this current entirely to the secondary side. This results in a voltage spike from the drain to source which could damage the FETs. CR12 absorbs that current and protects the FETs.

1-25. Flyback Detection and Oscillator/Timer. The oscillator/timer circuitry determines the primary coil on time. The length of the off time is determined by the flyback detection circuit. Peak efficiency is assured by causing the oscillator/timer to wait until the end of flyback before turning on.

Q9 holds the FET drive off as long as there is a positive voltage at T1, pin 12. C7 is used to speed up the turn on of Q9. CR17 insures that there is always enough voltage at T1, pin 12 during flyback to turn on Q9, even at start-up, when all the caps are discharged.

1-26. Control Feedback. The control section generates an error voltage at U4B, pin 7, which is used by the oscillator/timer section to determine the T1 primary on time. The higher the error voltage, the longer the primary on time, and the greater the power output. The +5V supply is applied to U4B, pin 6, and compared with the +5V UNSW reference. The resulting error voltage varies inversely to the +5V supply. The feedback circuit, RN6, C13, and C12, provides stability and response time. CR10 and CR11 prevent the output of U4B from rising much above +9V.

1-27. Long-Term Current Limit. The long-term current limit circuit normally has no effect on the control section. If the error voltage at U4B, pin 7, remains above +5V long enough to charge C11 to above +5 UNSW, then comparator U3D turns on and pin 13 drops to ground. This quickly discharges C15. Error amplifier U4B now tries to make the +5V supply match this discharge voltage. The error voltage at U4B, pin 7, drops to almost ground and shuts down the power supply. It also eventually discharges C11 to below +5V UNSW and the voltage on C15 is allowed to rise back up to +5 UNSW again. This cycle will repeat itself until the abnormal load is removed. Note that an error voltage greater than +5V corresponds to a power output greater than 45W.

1-28. Defibrillator Serial Data Receiver. This circuitry receives Defibrillator signals either through the optical interface, when Monitor and Defibrillator are mechanically connected, or through a SYSTEMS connector cable.

For optically received data, $\overline{\text{DEFIB CABLE}}$ goes high allowing data to pass inverted through U32D. The +5 UNSW is connected to the collector of a photo-transistor in the optical interface, DEFIB DATA 1 to the emitter and DEFIB DATA 2 to the base. The 200kΩ resistor, RN4, increases the speed of the photo-transistor while decreasing its sensitivity. With about 0.6mA of emitter current through the 4.99kΩ resistor, U32D, pin 5 goes high. Therefore, when light is detected, both inputs of U32D are high. The resulting low output is passed through CR102.

The anode of CR21 can also be pulled low by U21 during cable operation since it is ORed with U32D. Having the SYSTEMS cable connected grounds DEFIB CABLE which disables U32D. Opto-isolator U21 provides electrical isolation between the Monitor and the Defibrillator during cable operation.

From either the anode of CR102 or U21, pin 5, the data signal passes through two inverters, U32A and U22A, which are powered by +5V. The signal can then interface safely with other +5V digital circuitry. R126 prevents misoperation of U22A if +5 UNSW and +5V are not close in value.

1-29. Wake Up Message Decoder. The purpose of the wake up feature is to allow turning on of both the Monitor and the Defibrillator by pressing only the Defibrillator ON button when the two are connected. The wake up message decoder looks for a string of four alternating ones and zeroes, delivered at exactly 244 Baud, equivalent to four cycles of a 122Hz square wave. When this happens, counter U30 is clocked four consecutive times without a reset, and the third bit (Q3) goes high. This causes the monostable multivibrator U29B to fire a positive pulse which turns on the Monitor by setting U2B.

The monostable multivibrators U28A and U28B are set so that when their outputs are NANDed together, a logic low pulse is generated concurrently with the clock pulse from U29A which only occurs for a 122 Hz square wave. If the reset input is only enabled during the clock pulse, and the NANDed signal is used for the reset, then reset does not occur and the counter counts up. If anything other than a 122Hz square wave is detected, a reset will get through and the counter will not set the third bit.

1-30. Wake Up Suppression. The wake up suppression circuit allows the user to turn off the Monitor and keep it off without disconnecting it from the Defibrillator. When the power supply turns on, U32C detects the presence of the +5V supply and sets flip-flop U27. This prevents U29B from delivering any more wake-up pulses. U27 cannot be cleared until the Q output of U26 goes low. U26, a retriggerable monostable multivibrator, will remain set 234ms after the last Defibrillator serial data pulse is received, which happens when the Defibrillator is turned off. Therefore to have the Defibrillator turn on the Monitor, the Defibrillator must be cycled from off to on.

1-31. Sync Signal Encoder. The sync signal is frequency encoded. SYNC CHANNEL ENABLED is an 8kHz signal, while the SYNC PULSE signal is 32kHz. Counter U23 provides 8kHz and 32kHz signals by dividing the 1MHz E clock. U24 and U22B gate these signals according to the SYNC ENABLE and SYNC PULSE inputs.

1-32. Interface Drive. The interface drive circuit provides sync data, of appropriate signal amplitude, to the Monitor optical coupler. When the sync channel is enabled, an 8kHz SYNC ENABLED signal is fed to the interface. A 32kHz signal that represents SYNC PULSE is gated to the optical coupler whenever an R wave is detected. The Defibrillator receiver circuits are designed to detect narrow, high intensity infrared pulses.

The output from sync signal encoder U24B, pin 6, is applied to transistor driver Q21. When U24B, pin 6 is high, Q21 is off. When Q21 is turned on, the infrared drivers receive a 60mA peak current spike that has a decay time constant by 1.5µs.

CR105 and CR106 insure that the 1.5µs time constant is maintained even with the OPTO SYNC and SYNC CABLES disconnected. R108 and C112 decouple the driver circuit from the +5V power supply for noise reduction.

1-33. Audio Amplifier. The audio amplifier circuitry is based on U201, an integrated 1.2W audio amplifier. Input signals from either TONES or ALARM VOL are first bandpass filtered before being summed at pin 3 (signals will appear at only one input at a time). Gain is set by R307 to about 34dB (gain of approximately 50). Capacitor C304 limits the high end response to 20kHz. The output goes through connector J2 to an 8 ohm speaker.

1-34. Watchdog. The watchdog circuit monitors the Executive microprocessor (U6, Control PCB, see Figure 5-12) for errors in the program operation. If an abnormality is detected, the SERVICE legend is illuminated and the Executive microprocessor is reset.

During normal operation, a 100 to 125Hz signal, with a 60µs pulse width, is present at WD RESET. A retriggerable monostable multivibrator, U102, with a pulse width of 16.9ms, is held in the set condition only as long as the WD RESET is of the proper frequency. A decrease in the retrigger frequency would allow the WATCHDOG to reset thus signaling a program fault.

Should the WD RESET increase in frequency, or become stuck high, C203 will begin to charge through RN3. These components are connected to U102 (reset), pin 9. If the voltage at U102, pin 9, is high enough, the WATCHDOG will be reset and again signal a program fault.

The Q output of U102 is high in normal operation and transitions low when faulty operation is detected. When Q is low, Q31 is turned on to provide a high current +5V source for other Monitor circuitry. Note that WD Q and WDG Q are of the same polarity.

1-35. Voltage Monitor. The voltage monitor circuitry is intended to prevent unpredictable behavior which may occur when power supply voltages drop. It also assures predictable start-up behavior.

During start-up, both $\overline{\text{RESET}}$ and $\overline{\text{STANDBY}}$ start out low. A few milliseconds into startup, the supply voltages have risen and comparators U101A, U101C, and U101D shut off and C202 starts charging through RN2 (59kΩ). Soon after, U101B shuts off and C201 charges through RN3 (100kΩ). Due to a smaller RC time constant, C201 charges first so that the $\overline{\text{STANDBY}}$ line goes high first. The $\overline{\text{RESET}}$ line goes high about 100ms later.

During operation, small drops in the +5V supply (to just below 4.7V) will cause the $\overline{\text{STANDBY}}$ line to go low, and freeze the microprocessor. Greater drops in voltage will cause a full reset.

1-36. ECG PCB ASSEMBLY (802833).

The ECG PCB (see Figures 1-8, ECG PCB Block Diagram and 5-11) is the primary processor of patient generated electrical signals. Circuitry is provided for gain control and filtering of these signals so they may be used in the rest of the LIFEPAK 8. A microprocessor controls all operations performed by the ECG PCB. The microprocessor exchanges information with the Gateway and Control PCBs through the serial data loop. In addition the ECG PCB performs the following functions: R wave detection, sync pulse generation, heart rate calculation, demodulation of QUIK-LOOK ECG, electronic lead selection, leads off detection, and heart rate alarms.

1-37. ECG Microprocessor. The microprocessor, U19, is a 6301, 8 bit single chip microprocessor with 4K bytes of internal ROM. This memory space contains the special purpose program that is required for control of ECG Preamp PCB signal processing. The microprocessor clock is derived from an external 4MHz crystal, Y1.

The $\overline{\text{RESET}}$ line, fed from the Monitor power supply to U19, pin 6, is held low for the first 100ms of power application. When $\overline{\text{RESET}}$ goes high, the microprocessor latches I/O Port 2, bits 0, 1, 2 into the program control register, selecting mode 5 (nonmultiplexed/partial decode) which programs the I/O ports as follows:

Port 1 - Parallel I/O only, U19, pins 13-20
Port 2 - Parallel and serial I/O, U19, pins 8-12
Port 3 - Data bus, U19, pins 30-37
Port 4 - A(0-3) and input only, U19, pins 22-29

The starting address of the program is also loaded into the program counter when $\overline{\text{RESET}}$ goes high.

Also at power-on the state of DIP switch S1 is read by U19, pins 14 through 17, to configure software. S1-1 (the rocker switch closest to the rear of the Monitor) selects 50/60Hz notch filter for PADDLES (open = 60Hz). S1-2 through S1-4 should also be open during normal operation.

Circuitry connected to the data bus is selected and enabled through decode logic. The dual multiplying DAC, U17, is selected when E and A1 are high and IOS is low. U16C, pin 8, goes low, enabling data to be written to DAC A or B depending upon the state of A(0). Data is read from analog to digital converter, U29, when E and A2 are high and IOS is low. This data is manipulated by the program for R wave detection or digital filtering as required.

Serial data packets from the Control PCB, pass through U19 carrying information about the Monitor system. Alarm limit, CAL, SYNC ON, GAIN, and PACE ON information is loaded into the microprocessor. HEART RATE, ALARM HIGH, LOW TRIP and LEADS OFF are sent out to the Gateway PCB (See Figure 5-13).

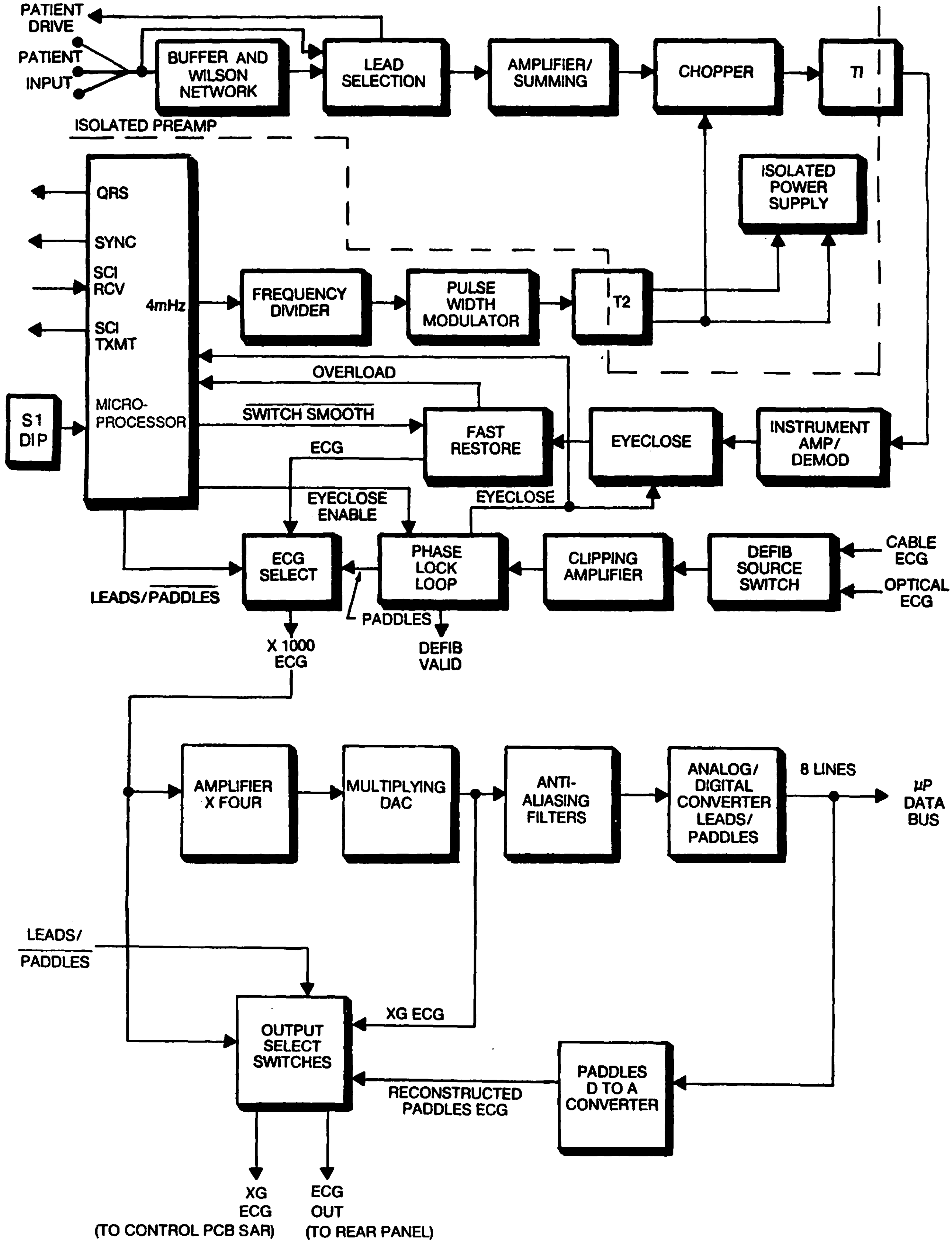
PATIENT DRIVE
PATIENT INPUT
BUFFER AND WILSON NETWORK
LEAD SELECTION
AMPLIFIER/ SUMMING
CHOPPER
T1
ISOLATED PREAMP
ISOLATED POWER SUPPLY
QRS
SYNC
SCI RCV
4mHz
SCI TXMT
MICRO-PROCESSOR
S1 DIP
FREQUENCY DIVIDER
PULSE WIDTH MODULATOR
T2
OVERLOAD
SWITCH SMOOTH
FAST RESTORE
EYECLOSE
INSTRUMENT AMP/ DEMOD
ECG
EYECLOSE ENABLE
EYECLOSE
ECG SELECT
PHASE LOCK LOOP
CLIPPING AMPLIFIER
DEFIB SOURCE SWITCH
CABLE ECG
OPTICAL ECG
LEADS/PADDLES
PADDLES
X 1000 ECG
DEFIB VALID
AMPLIFIER X FOUR
MULTIPLYING DAC
ANTI-ALIASING FILTERS
ANALOG/ DIGITAL CONVERTER LEADS/ PADDLES
8 LINES
µP DATA BUS
LEADS/ PADDLES
OUTPUT SELECT SWITCHES
XG ECG
RECONSTRUCTED PADDLES ECG
PADDLES D TO A CONVERTER
XG ECG (TO CONTROL PCB SAR)
ECG OUT (TO REAR PANEL)

FIGURE 1-8. ECG PCB BLOCK DIAGRAM

Inputs and outputs of the ECG microprocessor are listed below:

QRS - software detects and sends out at U19, pin 20. SYNC Pulses are generated within U19 and delivered through pin 19.

CAL - active when the user wishes to inject a known signal into the preamp.

LEAD SELECT - outputs enable the user to look at the patient's ECG through different lead combinations. Port 1, bits 1, 2, 3 provide a LEAD SELECT word that is decoded by the isolated preamp enabling certain leads to be processed by the Monitor.

LEADS/$\overline{\text{PADDLES}}$ - enables switching circuits for routing lead or paddles ECG through the system.

EYECLOSE ENABLE - active whenever the Pacing Cassette is on; allows ECG to be disabled during pacing pulse and is also used during fast restore.

$\overline{\text{SWITCH SMOOTH}}$ - is fed to the ECG baseline restore circuit whenever a new lead is selected.

EYECLOSE - received from the Defibrillator when a pacing pulse is imminent.

OVERLOAD - is received when the baseline restore circuit is triggered.

1-38. Isolated Power Supply. Isolated dc voltages are necessary to protect the patient from hazardous leakage currents. Circuitry in the isolated preamp requires +15V and -15V. Nonisolated +15V is modulated into a 34.5kHz square wave and transformer coupled to a full wave bridge rectifier in the isolated secondary. This rectified signal is then filtered for use by the isolated preamp.

The 34.5kHz transformer drive, applied to the primary of T2, is generated by a triggered pulse width modulator, U6. A 69kHz square wave, applied to the gate of Q2, is obtained from counters U22 and U23 which are configured to divide the 4MHz clock by a factor of 58. The drain of Q2 is tied to a network that triggers U6 to operate at 34.5kHz. Diodes CR6 and CR7 clamp the U6 outputs to +15V for protection from voltage transients.

The isolated 34.5kHz, present on the center-tapped secondary of T2, is applied to a full wave bridge rectifier, CR3. Positive signal excursions at the ac inputs to CR3 are stored on C16 and become isolated +15Vdc. Negative swings are stored on C17 and become isolated -15 Vdc.

1-39. Isolated Preamplifier. The isolated preamplifier provides input buffering, lead selection, common mode rejection and patient protection from leakage currents. The output ECG is modulated and transformer coupled across the isolation barrier for additional amplification and signal processing.

ECG signals are coupled into the preamp through J3, from a three, four or five lead cable attached to patient electrodes. Surge protectors, VSP2 through 6, prevent introduction of large voltages to the preamp during delivery of a defibrillation pulse. U12, a monolithic quad op amp, is a unity gain buffer. The outputs of U12 are applied to the Wilson network, RN5, a summing array. The sum fractions, available at the various outputs of RN5, correspond to different lead combinations; AVR, AVL, AVF, and V. Leads I, II, and III are not summed through the Wilson network.

Lead selection is accomplished electronically by the eight channel analog demultiplexers U38 through U40. A three bit control word, supplied by the ECG microprocessor, is applied to the opto-isolators U25 through U27. A high on pin 1 of CNY65 (U25 through U28) turns on the internal transistor, grounding one of the control lines of U38 through U40. If any opto-isolators are off, pull-up resistors in RN10, force these control lines to +15V, enabling a selected input to the analog demultiplexer output pin 8. A truth table for U38 through U40 follows:

Control Pins			Output Pin	Selected
15	16	1	8	Lead
0	0	0	S1	Paddles/STD
0	0	1	S2	I
0	1	0	S3	II
0	1	1	S4	III
1	0	0	S5	AVR
1	0	1	S6	AVL
1	1	0	S7	AVF
1	1	1	S8	V

The outputs of U38 and U39 are fed to the noninverting inputs of U1, a differential amplifier with a nominal gain of 10. Outputs at U1, pins 1 and 7, are summed together at the junction of R17 and R18 for application to the right leg drive circuit. These outputs are also applied to U4, a dual SPDT analog switch, where they are modulated by the 34.5kHz preamp drive tapped from T2, pin 3. The modulated ECG is transformer coupled, in T1, to the nonisolated preamp.

In the right leg drive circuit the summed ECG, from R17/R18, is inverted, and fed to U40, pin 8. Depending upon the lead select code, the right leg drive is routed to the appropriate patient lead. This drive cancels noise that may be induced into the Monitor/patient system.

1-40. Nonisolated Preamplifier. The modulated ECG signal is fed from the secondary of T1 to U5, a dual SPDT analog switch, which switches at a frequency of 34.5kHz and demodulates the ECG from the isolated preamp. U7A functions as a unity gain subtractor which takes all signals common to both inputs and removes them from the output at U7A, pin 7. Modulation noise is suppressed by C19 and C20.

A calibration signal may be switched into U7A, pin 5, through U10 pins 2 and 3. The 10mV CAL signal is derived from a +5.1V reference in U6 and divided by RN17. Pressing the Front Panel CAL key causes U10 to output the calibration signal.

The ECG from U7A, pin 7, passes through Eyeclose switch, U9. This switch isolates the ECG signal circuitry from pacing pulses. When the Pacing Cassette is on, switch U36 is closed between pins 10 and 11. This allows the EYECLOSE signal appearing as a high at U35A, pin 14, to pass through U36 and turn U9 off (i.e. U9A and U9C are opened and U9B is closed).

The ECG signal output from U9, pin 10, is applied to the non-inverting input of U7D. This op amp stage serves as a low-pass filter, eliminating any switch-bounce from U9. The output signal of U7D is then passed to a bandpass amplifier that has a nominal gain of 50.

DC offsets of ± 4V or greater at U7B will trigger an output from the baseline restore window detector at U30, pin 1. The resulting negative output prevents U7A, pin 7 from latching at a voltage rail condition. At the time U30A, pin 1 goes low, Schmitt trigger U15E, pin 8, will go high. The result is an OVERLOAD signal to the ECG microprocessor that inhibits R wave detection routines.

The baseline is restored through U7C when U30A activates Q4, which turns Q3 off. The ECG microprocessor closes U9D, pins 6 and 7, by activating the $\overline{\text{SWITCH SMOOTH}}$ line for approximately 20ms in response to the OVERLOAD signal. The charge stored on C82 holds Q3 on for approximately 4 seconds.

U8A is configured as a X2 amplifier providing a total gain of 1000.

1-41. Paddles ECG Demodulator. The paddles ECG is frequency modulated and passed through the optical interface or directly through an interconnect cable. Several functions are performed in the demodulator circuit: signal source selection, frequency demodulation, Defibrillator validation, and eyeclose detection.

Frequency modulated ECG is input through P1, pin 2A, or P1, pin 5B. U37 optically isolates the Defibrillator cable input. Connection of the cable grounds P1, pin 2B, which in turn pulls U36, pin 6, low. The output at U37, pin 3, is now switched to U36, pins 2 and 5. Paddles signal from P1, pin 2A, is present at U36, pin 5, with no Defibrillator cable connected.

The selected paddles signal is ac coupled through C69 and amplified by U33A and U33B. Capacitor C60 decouples the output of U33 for application to the phase locked loop (PLL), U34. The PLL converts ac to dc with an increased frequency resulting in a greater dc output. The paddles ECG center frequency is 15kHz and deviates ± 5kHz when actively transmitting information. A 32kHz signal is present on the paddles ECG line whenever the Pacing Cassette requests Eyeclose otherwise an 8kHz signal is present.

The demodulated analog signal from U34, pin 11, is applied to amplifier U35A. U34, pin 11, output is also sensed by the $\overline{\text{EYECLOSE}}$ and $\overline{\text{DEFIB VALID}}$ comparators U35D and U35C. U35C, pin 9, is compared to a voltage reference that represents a 4kHz minimum carrier input from the paddles interface. U35D, pin 6, is compared to a reference representing a 32kHz Eyeclose carrier present at the paddles interface. If either of these comparators is toggled, appropriate circuits will be enabled.

LEADS/$\overline{\text{PADDLES}}$ is applied to U10, pin 9, and is used to select which ECG source will be present at the X1000 ECG output.

1-42. Anti-Aliasing Filter. An A/D converter must sample at a frequency at least twice that of the highest frequency present in the analog signal. It is possible, however, that an unwanted high frequency component of the analog signal may be sampled. Anti-aliasing filters have been incorporated to prevent this.

The amplified ECG signal is applied to a 600Hz twin T-notch filter made up of C27 through C30, R73 through R77, and U13A. U13B forms a 250Hz low pass filter. From U13B, pin 8, the ECG is sent through buffer amp U13C to A/D converter U29.

1-43. A/D Converter. The analog ECG signal is converted to an eight bit word by U29, the A/D converter. This chip performs a complete successive approximation cycle in 15us, as determined by the RC time of R88 and C37. Conversion starts when the $\overline{\text{RD}}$ line, U29, pin 15, goes high. The ECG microprocessor then goes on to other program functions and loops back to fetch the conversion word. When $\overline{\text{RD}}$ goes low, the data is placed on the bus, loaded into the ECG microprocessor where it is evaluated for R wave detection. Then when the instrument is in the paddles mode, the data is digitally passed through a notch filter.

1-44. Gain Control and D/A. The ECG PCB must provide ECG signals of appropriate size for the CRT display. One half of a dual multiplying DAC is used for D/A conversion so that paddles ECG may be reconstructed for CRT display; the other half is an electronic attenuator used for gain control.

CRT and Recorder ECG size is determined by U17B in conjunction with serial data decoded by the U19. X1000 ECG is amplified by a factor of four in U8B, and applied to U17, pin 18.

An eight bit word, representing the ECG size, is latched from the data bus into the DAC B register when U17, pin 16, is low and U17, pin 6, is high. This eight bit word is applied to a R2R network within U17 which sets the ratio for the op amp U8C. In this manner, the ECG will be multiplied by a factor of one or less. This ECG signal is routed to the anti-aliasing filter and the output select switch, U14.

ECG digital data is converted to an analog signal by U17A. The data is loaded, from the bus, into the DAC A register where it controls the amount of the -10V reference that is to be amplified by U8D. This -10V reference is generated by U13D using as reference the +5.1V from U6. The output of U8D is then routed to the output select switch.

The LEADS/$\overline{\text{PADDLES}}$ control from U19, pin 18, selects which source is to be present on the CRT and at the ECG output jack. When U14, pins 9 and 6, are high, XG ECG will be fed from U8C, pin 1, and ECG OUT will be equal to X1000 ECG. In PADDLES, U14, pins 9 and 6, are low, XG ECG and

ECG OUT are fed by U8D, pin 7. This is a gain adjusted signal and not a X1000 ECG output. Buffering of these outputs is provided by U33D and U30B. Op amp U35B forms a reconstruction filter for U17.

1-45. CONTROL PCB ASSEMBLY (802827).

The Control PCB (see Figures 1-9 thru 1-11 and Figure 5-12) consists of two functional parts, the executive microprocessor and the display controller. The Executive microprocessor circuitry serves as the interface between the user and the LP 8 system. The display controller provides the timing signals and memory functions for both the alphanumeric raster and analog trace displays.

1-46. Executive Microprocessor. The Executive microprocessor, U6, provides the mode logic for the entire LP 8 Monitor. This is a HD6303 microprocessor with 128 bytes of internal RAM and no internal ROM. It executes software resident in the executive EPROM U15. The microprocessor accesses the EPROM through the eight bit address/data bus, buffered by U7 and multiplexed by U16. The upper addresses are directly applied to the EPROM and the chip select input is provided by decoder U8. This decoder is also used to address control latches and text RAM.

The microprocessor controls the system through three latches: Audio Control Latch U17, Display Control Latch U35, and Analog Control Latch U31.

The microprocessor clock consists of crystal Y1 and capacitors C9 and C10. The microprocessor divides this 4MHz down and provides a 1MHz, E clock output. This signal is combined with the 4MHz signal through flip-flop U9, an OR gate, and 2 inverters to provide a signal used to clock data into the mode control latches.

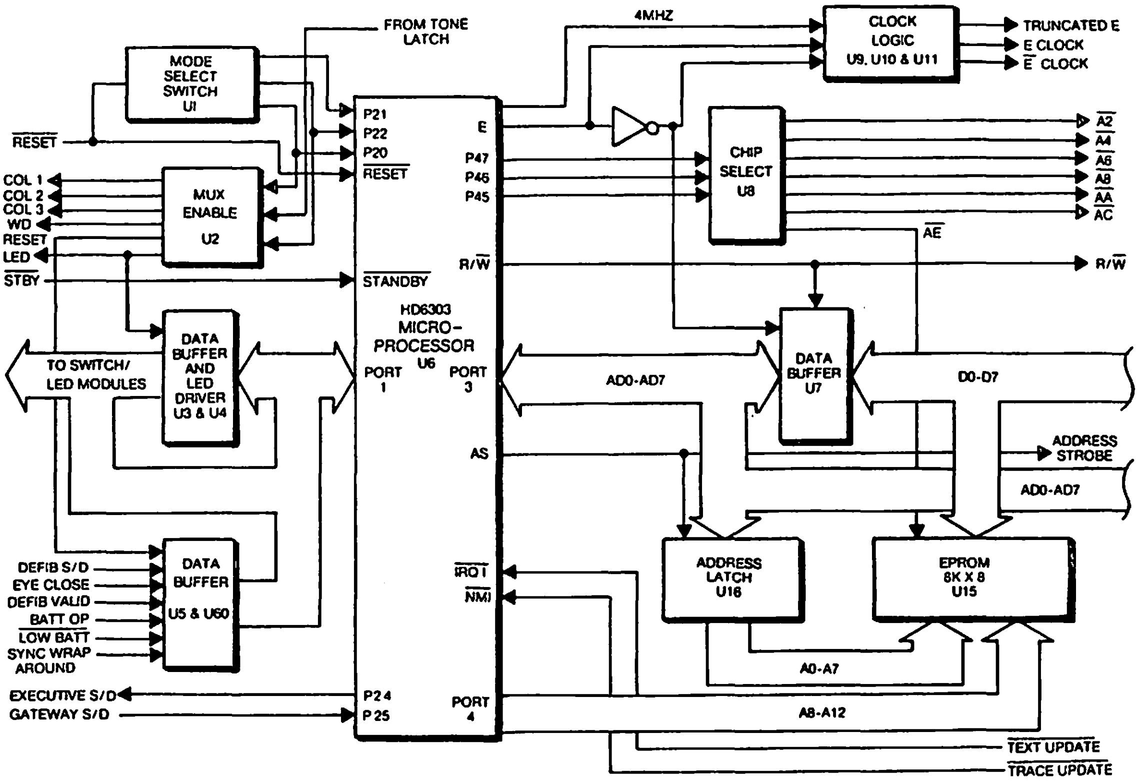
FROM TONE LATCH
MODE SELECT SWITCH U1
RESET
COL 1
COL 2
COL 3
WD
RESET
LED
STBY
MUX ENABLE U2
P21
P22
P20
RESET
E
P47
P46
P45
R/W
STANDBY
HD6303 MICRO-PROCESSOR U6
PORT 1
PORT 3
AS
IRQ1
NMI
P24
P25
PORT 4
4MHZ
CLOCK LOGIC U9, U10 & U11
TRUNCATED E
E CLOCK
E CLOCK
CHIP SELECT U8
A2
A4
A6
A8
AA
AC
AE
R/W
DATA BUFFER U7
AD0-AD7
D0-D7
ADDRESS STROBE
AD0-AD7
ADDRESS LATCH U16
EPROM 8K X 8 U15
A0-A7
A8-A12
TEXT UPDATE
TRACE UPDATE
TO SWITCH/ LED MODULES
DATA BUFFER AND LED DRIVER U3 & U4
DATA BUFFER U5 & U60
DEFIB S/D
EYE CLOSE
DEFIB VALID
BATT OP
LOW BATT
SYNC WRAP AROUND
EXECUTIVE S/D
GATEWAY S/D

FIGURE 1-9. CONTROL PCB: EXECUTIVE SECTION BLOCK DIAGRAM

1-47. Keyboard Interface. The Executive microprocessor and peripheral circuitry provide the interface for the Monitor keyboard and various signals generated by the LP8 Defibrillator.

The Monitor front panel keyboard is organized electrically as 3 columns of dome switches and 1 column of LEDs. There are 8 rocker switches (service switches, S1) on the Control PCB that are also read. In order to read the switches, U6 enables each column (in sequence) by applying the appropriate code to decoder U2 through port 2. This turns on the appropriate PNP transistor (Q1 through Q4) which then applies +5V to the switch column. If a switch is closed, the +5V is applied to a row which is relayed to the microprocessor through port 1.

Port 1 acts as an input port for both keyboard and Defibrillator inputs, and as an output port for driving LEDs. The input path is through RN3, the output path is through U4. Most of the time however is spent driving the LEDs. The keys are scanned every 8.2msec. for approximately 150μs. The service switches and column 1 switches are scanned sequentially, then 1ms later the column 2 and column 3 (FREEZE) switches are scanned. The Defibrillator inputs are scanned every 1.024ms through port 1 and tri-state buffers U5 and U60 (their outputs are enabled by decoder U2 and microprocessor port 2).

1-48. Audio Interface. The microprocessor, through the tone latch U17, provides the user with audio alarms, QRS beep volume control, and an audible key click each time a push button is pressed. The audio alarms are provided by gating the outputs of frequency divider U27 and pins 15 and 16 of the tone latch U17 through U20C and U20D. The gated outputs are applied through resistors to amplifier U22C and then sent to an audio amplifier on the Power Supply PCB which drives the speaker.

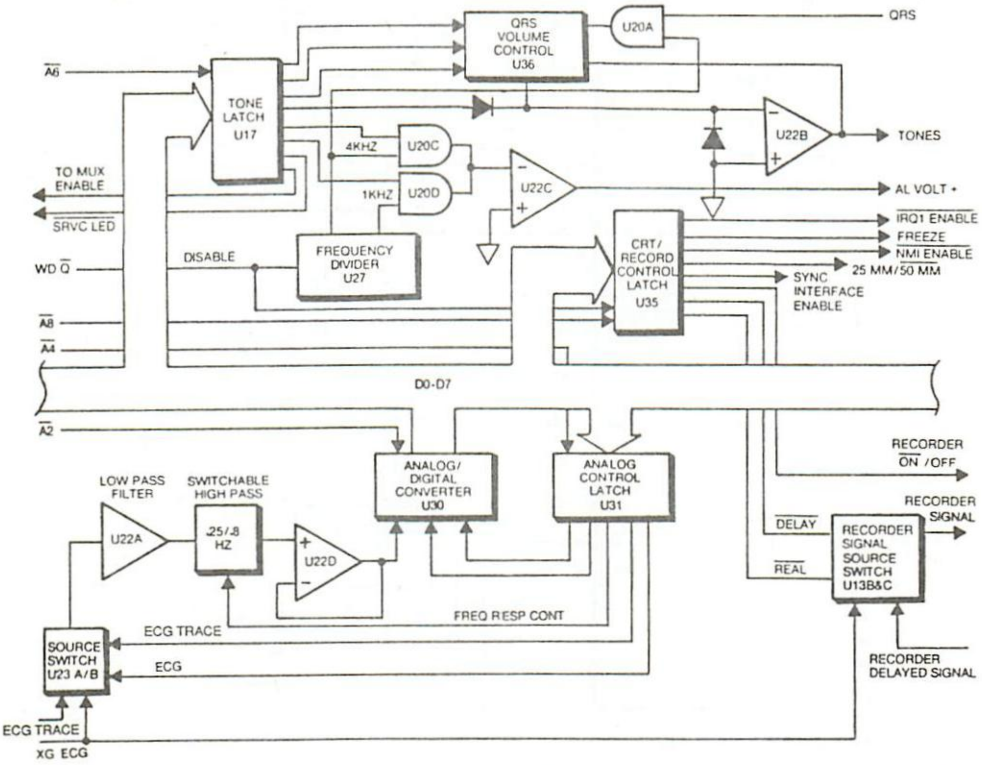
QRS VOLUME CONTROL U36
U20A
QRS
$\overline{A6}$
TONE LATCH U17
TONES
4KHZ
U20C
1KHZ
U20D
U22B
U22C
TO MUX ENABLE
$\overline{SRVC LED}$
AL VOLT +
$\overline{IRQ1 ENABLE}$
FREEZE
$\overline{NMI ENABLE}$
25 MM/50 MM
WD $\overline{Q}$
DISABLE
FREQUENCY DIVIDER U27
CRT/ RECORD CONTROL LATCH U35
SYNC INTERFACE ENABLE
$\overline{A8}$
$\overline{A4}$
D0-D7
$\overline{A2}$
ANALOG/ DIGITAL CONVERTER U30
ANALOG CONTROL LATCH U31
RECORDER $\overline{ON}$ /OFF
LOW PASS FILTER
SWITCHABLE HIGH PASS
U22A
.25/.8 HZ
U22D
RECORDER SIGNAL
$\overline{DELAY}$
$\overline{REAL}$
RECORDER SIGNAL SOURCE SWITCH U13B&C
FREQ RESP CONT
ECG TRACE
ECG
SOURCE SWITCH U23 A/B
RECORDER DELAYED SIGNAL
ECG TRACE
XG ECG

FIGURE 1-10. CONTROL PCB: CONTROL SECTION BLOCK DIAGRAM

The QRS volume (systole beep) is adjustable through eight tone levels by digitally varying the gain of U22B. A 40ms QRS pulse AND-ed with 4kHz at U20A is applied to an R2R ladder consisting of RN7 and RN8. A three bit code from outputs Q2 through Q4 of tone latch U17 causes U36 to switch different resistor combinations into the input of U22B. This provides the adjustable gain.

The audible key click is controlled by U17, pin 12. This output is applied to amplifier U22B through CR14. The microprocessor applies a 60μs pulse to this stage whenever it detects a push button being pressed.

1-49. Display/Recorder Interface. The Executive microprocessor controls the operating mode of the Recorder and the CRT through display control latch U35. Two of the latch outputs are used as hardware interrupt enables/disables (pins 2 and 6). Pin 2 gates the text interrupt ($\overline{\text{IRQ1 ENABLE}}$) to the microprocessor; pin 6 gates the trace interrupt ($\overline{\text{NMI ENABLE}}$). When U6 receives a text interrupt, it updates the CRT message fields. When a trace interrupt is received, the microprocessor takes a new ECG trace A/D sample and writes the new sample to the trace latch, U61.

U35, pins 5 and 9 provide the trace FREEZE and SWEEP SPEED features and are direct inputs to U58, the no fade gate array.

U35, pins 12, 15, and 19, are Recorder control lines. A low output on pin 19 turns the Recorder on. Pins 12 and 15 provide the following logic when the Recorder is on:

Pin 12	Pin 15	Result
0	0	Illegal
0	1	Delay Record
1	0	Diagnostic Record
1	1	Recorder pen railed (This only happens when Recorder is in Delay mode.)

U35, pin 16, provides the sync interface enable signal which allows the LP 8 to perform synchronous cardioversion. This signal is also used in pacing.

When a text interrupt is received by U6, the Executive microprocessor updates the CRT Text RAM U47. U6 has access to the text RAM for a minimum of 1.0ms following the falling edge of the text update signal at analog switch U13D, pin 14. The microprocessor accesses the Text RAM through data buffer U19 and address latch U18. The decoder U8 is used to provide enable and read/write signals to the buffer, latch and RAM.

The analog control latch U31 controls the low end cutoff of the ECG trace input to the cardioscope. It is used to trigger and read the trace A/D converter and to select either a peripheral device trace or the ECG preamp trace.

1-50. Analog Circuitry. The only analog input to the executive portion of the control board is the ECG trace input circuit at J1, pins 28A and

28B. This circuitry consists of two gain stages and low and high pass filters. The input is selected by the analog control latch, U31. The trace signal is switched by analog switch U23A, U23B, applied to an active low pass filter with a gain of 2, and then applied to a high pass filter with a cutoff frequency of either .25 or .8Hz. This is selectable by one of the service switches on S1 (Refer to paragraph 1-47). U31 selects .25Hz based on input from U23C except when PADDLES are chosen, then U31 always selects .8Hz.

The trace signal is then buffered with voltage follower U22D and applied to A/D converter U30 which is connected to the microprocessor data bus.

1-51. Trace Controller. The no fade analog display, sync marker generation, waveform reconstruction, and Recorder memory circuitry functions are all implemented by the trace controller circuitry and no fade gate array, U58.

The E clock of microprocessor U6, is prescaled by raster controller gate array, U49, to provide U58 with a 400kHz clock signal.

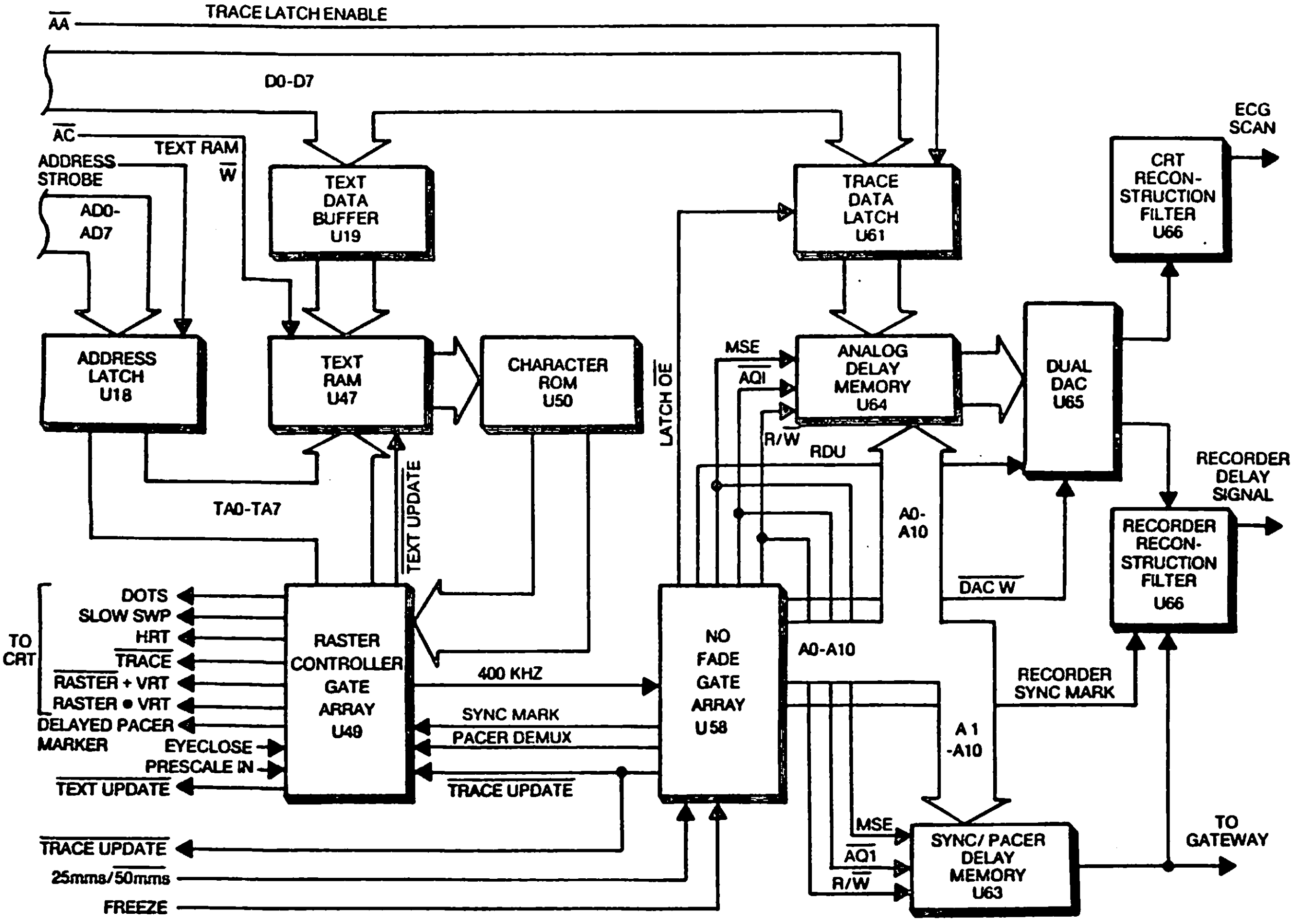
AA
TRACE LATCH ENABLE
D0-D7
AC
ADDRESS STROBE
TEXT RAM W
AD0-AD7
TEXT DATA BUFFER U19
TRACE DATA LATCH U61
ECG SCAN
CRT RECON-STRUCTION FILTER U66
ADDRESS LATCH U18
TEXT RAM U47
CHARACTER ROM U50
LATCH OE
MSE
AQI
ANALOG DELAY MEMORY U64
DUAL DAC U65
R/W
RDU
RECORDER DELAY SIGNAL
TA0-TA7
TEXT UPDATE
A0-A10
RECORDER RECON-STRUCTION FILTER U66
DAC W
TO CRT
DOTS
SLOW SWP
HRT
TRACE
RASTER + VRT
RASTER • VRT
DELAYED PACER MARKER
EYECLOSE
PRESCALE IN
TEXT UPDATE
RASTER CONTROLLER GATE ARRAY U49
400 KHZ
SYNC MARK
PACER DEMUX
TRACE UPDATE
NO FADE GATE ARRAY U58
A0-A10
RECORDER SYNC MARK
A1-A10
MSE
AQ1
R/W
SYNC/PACER DELAY MEMORY U63
TO GATEWAY
TRACE UPDATE
25mms/50mms
FREEZE

FIGURE 1-11. CONTROL PCB: DISPLAY CONTROLLER BLOCK DIAGRAM

The duration of the no fade cycle is variable depending on the state of the FREEZE and 25mms/$\overline{\text{50mms}}$ control lines. If FREEZE is high, then the cycle is 1024 address times long, or about 5.12ms. Although there are 2048 bytes of trace memory, only 1024 of these are addressed in any trace cycle, allowing the Recorder delay to be longer than the amount of data displayed on the CRT. In order to freeze the display, the starting address of each cycle must be identical.

When the FREEZE signal is low and the 25mms/$\overline{\text{50mms}}$ signal is high, the display enters a mode in which the analog data sweeps from right to left across the CRT at 25mm/s. In this mode, the no fade cycle is 1025 addresses long with the extra address time being devoted to Recorder update. Since the address is that of the oldest data in memory at the end of a cycle, the Recorder update occurs 10 seconds after the data was acquired. In addition to allowing Recorder update, the added address time causes the starting address to increase by one each cycle. Thus, the displayed frames add one byte of new data each trace cycle. As a result, the trace appears to move across the CRT.

In the 50mm/s mode, both the FREEZE line and the 25mms/$\overline{\text{50mms}}$ line are low. The cycle is 1026 addresses long, made possible by adding another Recorder update time at the end of the cycle. This results in the starting address of the cycle advancing by two addresses per cycle, or twice that of the 25mm/s mode. The visual result is a movement of data at double speed, or 50mm/s. Another effect of the double Recorder update is that unlike the previous mode, the newest data is written into two bytes and preserved since the next cycle does not cause overwriting of the older data. This results in the delay time of the buffer being reduced to 5 seconds. The recorder display is not affected by the double update since the data is the same in both bytes. In effect, the extra Recorder update has no effect on the Recorder, but allows a longer cycle time with a minimum of internal circuitry.

The addresses that have been discussed are internally generated in U58, the no fade gate array, and are used to address memories U63 and U64. Actual analog data is stored in U64 and is controlled by U58 through the R/W, MSE, and AQ1 lines. U63 is essentially in parallel with U64 and is controlled by the same signals. This byte wide memory is used for sync storage and eyeclose storage. The other six bits are unused. In addition, the bytes of U63 are mapped to U64 on a 1:2 basis, as is evident by the fact that A0 does not drive U63.

Digitized data is presented to the memory from U6, by U61, an octal tri-state latch. This latch is enabled only during memory write times by the no fade gate array signal LATCH OE. Data is latched into U61 by the microprocessor's, TRACE LATCH ENABLE. The executive software guarantees that a new byte of data is entered into the latch after receiving a $\overline{\text{TRACE UPDATE}}$ signal from U58 and before 5.12ms pass. TRACE LATCH ENABLE is generated at the end of each no fade cycle by the terminal count detection circuitry. The following are other memory control functions generated by the no fade gate array:

SIGNAL	FUNCTION
$\overline{\text{AQI}}$	Provides memory chip select function

RDU	Defines address periods during which the Recorder is updated
MSE	Defines address periods during which memory is updated

The data from the analog memory is bused to dual DAC, U65, which has internal latching.

U58, pin 10 is a power-on input signal to the U58. At power-on, this signal is low for 1.5 seconds. When this input is held low, the functions of LATCH OE, MSE, R/$\overline{W}$ and the address line A10 change slightly. Instead of indicating the read and write intervals as defined above, LATCH OE is always inactive, inhibiting data from U6. In addition, U58, pin 4 (MSE), is always high, disabling the memory outputs, and R/$\overline{W}$ is pulsed on every address. Since RN14 pulls the memory data lines to hexadecimal 80, this value is read into all memory addresses. To allow this to occur in 1.5 seconds instead of 10 seconds, the complementing of A10 at the end of a no fade cycle is inhibited when PWR UP is low. The 80 hex represents an output of zero in the offset binary representation used by U65. The result is that the no fade RAM is cleared to prevent random data from being displayed at turn on.

U66A and U66C form current to voltage buffers for the CRT and Recorder DACs respectively. Output voltages range from 0 to -5V. Components U66B, RN15, C58 and C59 form the first stage of four pole, low pass, Butterworth filter with a -3 dB point at approximately 37kHz. U66B also provides offset and scaling of the signal to within a range of +5V to -5V.

U66D, RN15, C64 and C65 form a low pass reconstruction filter for the Recorder system with a -3 dB point at 59Hz. However, the scaling and offset of this amplifier is such that the output range is +2.5V to -2.5V. An additional function is performed by this buffer. The synthesized sync marker for the Recorder is presented to the non-inverting reference terminal of U66D. Normally, this signal is at zero volts and the ECG is reproduced normally. However, when RECORDER SYNC MARK is high, the output of the Recorder buffer is driven toward the positive supply rail, generating the sync mark which is printed on the Recorder paper.

Easy selection of a 1cm/mV scale factor for European Monitors or a 1.76cm/mV scale factor for domestic Monitors is provided by S1, pins 8 and 9. When open, the ratio is 1:1 and the attenuation into the CRT deflection system is increased, since R40 forms a divider with the input impedance of the ECG buffer amp located on the CRT PCB. When this switch is closed, the ratio is 1:1.7, R40 is shorted, and there is no attenuation.

U67A provides a means of making one gain adjustment to calibrate both CRT and Recorder buffer gains. Matching of the monolithic DACs in U65 is excellent, as is the ratio tracking of the resistors in RN15. Thus, by varying the reference voltage to the DACs and the buffer amps, a single adjustment can be used. U67 forms a noninverting amplifier with a gain of 1.1 in series with an attenuator whose range is .78 to 1. The net result is an adjustable reference of approximately 5V.

The remaining function of U58 is that of sync marker generation. The delayed data is removed from U63 and internally processed by U58 to yield a single pulse at the rising edge of each sync period. CRT SYNC MARK *has* a duration of 5 microseconds whereas RECORDER SYNC MARK has a duration of 5.12 milliseconds. U60A provides isolation between the ECG microprocessor SYNC signal and the bidirectional DELAYED SYNC line.

1-52. Raster Controller. The raster controller gate array, U49, generates the timing and addressing necessary for the character display. The Executive microprocessor clock U6, pin 40, provides the 1MHz signal required for timing. Internal prescalers divide this frequency to 400kHz for the no fade gate array, U58, and 100kHz for the basic character time interval.

The state of the display at any time is determined by timing signals derived from U49 and the TRACE UPDATE and MSE signals from U58. The state transition sequence and timing are outlined below.

STATE	DURATION	EXTERNAL SIGNAL CONDITION
TRACE	5.12ms	TRACE = 0
HORIZONTAL RETRACE 1	1.26ms	HRT = 1; SLOW SWP = 1
RASTER	7.56ms	RASTER = 0
WAIT	5.04ms	TRACE = 1; HRT = 0 RASTER = 1
HORIZONTAL RETRACE 2	1.02ms	HRT = 1; SLOW SWP = 0

The internal timing signals are generated by a string of counters which also generate the addressing for the text RAM during the raster state. These counters essentially count the 18 characters per column of the display (15 visible characters during vertical sweep, 3 invisible characters during vertical retrace), seven vertical scan lines per character column, and six columns. Because a character requires seven scan lines to be formed, the address sequence for a character column must be repeated seven times. At the end of the last character column, the display controller enters a wait state. This wait state serves two purposes: it reduces the power dissipation in the display drivers by lowering the active duty cycle and it provides a dead time to take up minor timing discrepancies between the no fade gate array and raster controller gate array.

The text RAM, U47, is configured as a two port memory, accessible by both the raster controller gate array, U49, and the Executive microprocessor, U6. U18 is an address latch which demultiplexes the U6 address/data bus for accessing the dual port memory, and also serves to isolate the dual port memory address bus from that of the microprocessor. Similarly, U19 provides isolation between the dual port memory data bus and the Executive microprocessor address/data bus. Control of the dual port memory is granted to the microprocessor only during the horizontal retrace periods to prevent display disruption. A low $\overline{\text{TEXT UPDATE}}$ signal from U49, pin 9, provides an interrupt to U6 signaling the text RAM, U47, is available. At all other times U49 has exclusive use of U47.

Operation of U47 depends on the software in the Executive microprocessor to prevent prohibited accesses since the output enables of U18 and U19 are under direct control of U6. The chip select signal at U47, pin 18, is under the direct control of U49. The $\overline{\text{TEXT UPDATE}}$ signal from U49, pin 11, controls U10F and U33A which act as a 2:1 multiplexer. When the microprocessor U6, has access to the text RAM, the multiplexer switches the master E clock to the chip select line of U47. When U49 has access to U47, the DISPLAY CONTROL RAM ACCESS (DCE) signal, U49, pin 5, is switched to U47, pin 18.

Addressing of U47 by U49 is not sequential since operation requires scanning by column. Addressing by U6 is sequential, since messages are formed horizontally.

As a test feature, jumper JB1, pins 1 and 7, and resistor, R47, are provided to continually deselect U47. This allows the outputs of the text RAM to be pulled high by RN13. Since the microprocessor bus is isolated from the U47 bus during the raster display period, this selects the character code 7F hex, which corresponds to x. Removing jumper JB1, pins 1 and 7, will display all x's on the CRT providing a regular test pattern to allow easy verification of display operation.

The display requires approximately 108 bytes, only a small portion of the memory available in U47. The remaining memory is usable by U6 as auxiliary storage but it is accessible only during horizontal retrace.

RN12 provides series impedance between U18 and U49 in the event that both I.C.'s inadvertently try to drive the text address bus simultaneously. Normally the timing is such that this does not occur, however, this impedance limits the power dissipation in each component should bus contention occur due to hardware or software malfunction.

Gate array U49, pins 31 and 32, are signals which control vertical retrace and rastering. RASTER • VRT controls the vertical retrace amplifier by turning it on during the 30 microseconds corresponding to the invisible characters of each column. A high signal on this line indicates vertical retrace. $\overline{\text{RASTER}}$ + VRT controls the vertical sweep amplifier by turning it on during the 150 microseconds corresponding to the visible characters of a column. A low signal on this line indicates vertical sweep.

The blanking control of the video signal is controlled entirely by the internal circuitry of U49. In addition, it multiplexes the sync mark signal onto the DOTS video signal during the trace state. The net effect is to superimpose a high intensity dot on the ECG signal to represent a sync mark.

U49, pin 33, provides demultiplexing of the memory line in the trace controller to represent LIFEPAK 8 pacing activation. This multiplexed data line, PIO, is isolated from U6 signal line, $\overline{\text{EYECLOSE}}$, by U60B. The timing signal for proper demultiplexing of the pacing signal originates in U58 and is introduced to the U49, pin 34, PACER DEMUX. The recovered data is DELAYED PACER MARK, which is sent to the Recorder controller to be annotated.

The final function of U49 is to provide a timing signal for signature analysis (SA). This signal is not used in normal operation of the LP 8 and is provided solely as a service feature.

1-53. GATEWAY PCB ASSEMBLY (802835).

The Gateway PCB (see Figures 1-12 and 5-13) controls the exchange of data between a LP 8 Monitor and the Defibrillator, a Central Monitor System (CMS) or other external device. The Gateway PCB is able to transmit and receive both serial and parallel data. Parallel data is used only on the Gateway address/data bus. A serial data format is used for all communications external to the Monitor. Refer to paragraph 1-4 for additional serial data information.

The LP 8 Recorder PCB receives control signals, real time clock settings, and data for the annotating printer from the Gateway PCB. Real time data may then be read from the real time clock and encoded for serial transmission elsewhere.

1-54. Gateway Microprocessor. All functions performed by the Gateway PCB are controlled by the Gateway microprocessor, U1. Instructions from its program are decoded and executed to provide data or control signals to be used on the Gateway PCB and elsewhere. The microprocessor is a 6303, 8 bit processor. It does not have internal ROM so U4, an 8K by 8 bit EPROM, is used for memory.

During power-on U1 must be initialized. A 100ms $\overline{\text{RESET}}$, from the power supply, is applied to U1, pin 6. When $\overline{\text{RESET}}$ goes high, U1, pins 8, 9 and 10, are latched into the program control register, selecting Mode 2 (multiplexed mode) which programs the I/O ports as follows:

Port 1 - Parallel I/O only, U1, pins 13 through 20 (control lines).
Port 2 - Serial I/O only, U1, pins 11 and 12 (serial communication lines).
Low Address/Data (AD) - Address information when the address strobe (AS) is high and data when AS is low, U1, pins 30 through 37.
High Address - High byte of address, U1, pins 22 through 29.

1-55. E Clock. U1 supplies a 1MHz clock signal that is derived from an external 4MHz crystal, Y1. The E clock is the main timing clock for ACIAs U2 and U3 and for EPROM U4. The E clock signal is also used as a clock input for both the 14 stage frequency divider U13 and for the real time clock interface.

1-56. Address Cycle. The address strobe (AS) goes high when the low address byte is present and stable on the address/data bus. This address is latched into U6 and applied to the EPROM, U4, when AS goes high. The address (A0-A7) will remain latched in U6 until AS goes high again. High order address lines, A8-A15 of U1, are present during an entire machine cycle.

The three highest address bits, A13-A15, are applied to the high address decoder, U8. This three bit input is used to select one of eight outputs and drive it low. Six of these lines are used as enables for other Gateway circuitry.

READ/$\overline{\text{WRITE}}$ (R/$\overline{\text{W}}$) is high when U1 is reading data from the bus or when it does not care what is on the bus. R/$\overline{\text{W}}$ goes low when data is to be sent to an enabled peripheral device.

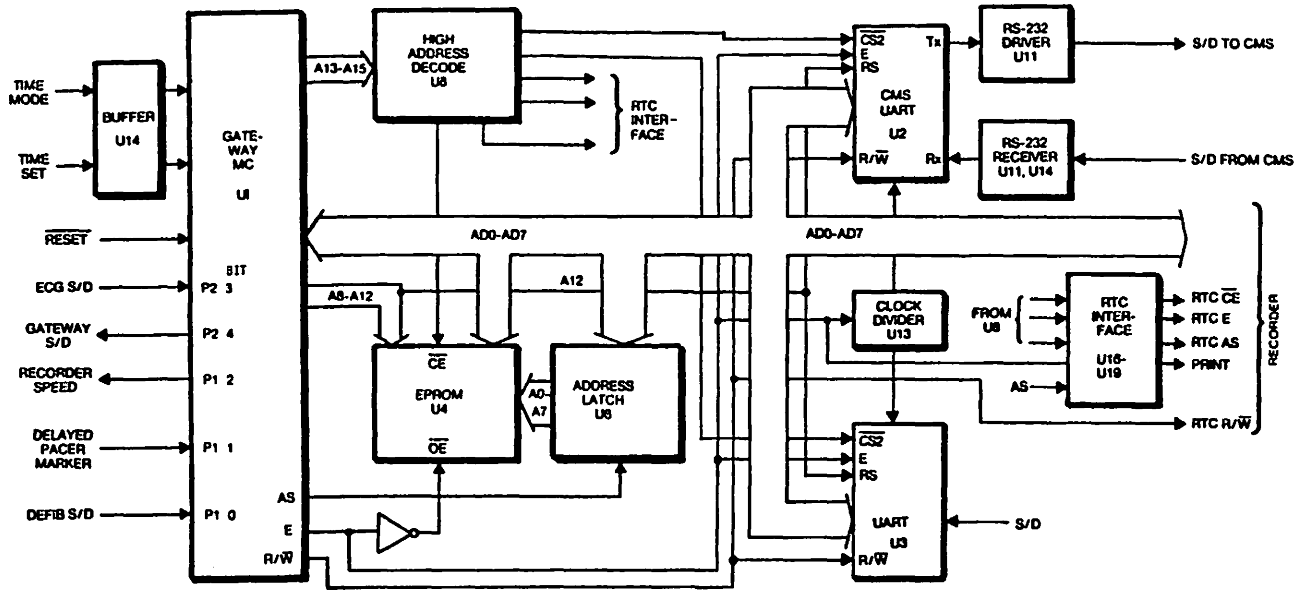
TIME MODE
TIME SET
BUFFER U14
GATE-WAY MC U1
RESET
ECG S/D
GATEWAY S/D
RECORDER SPEED
DELAYED PACER MARKER
DEFIB S/D
BIT
P2 3
P2 4
P1 2
P1 1
P1 0
AS
E
R/W
A13-A15
HIGH ADDRESS DECODE U8
RTC INTER-FACE
AD0-AD7
A8-A12
A12
CE
EPROM U4
OE
A0-A7
ADDRESS LATCH U6
AD0-AD7
CS2
E
RS
Tx
CMS UART U2
R/W
Rx
RS-232 DRIVER U11
S/D TO CMS
RS-232 RECEIVER U11, U14
S/D FROM CMS
CLOCK DIVIDER U13
FROM U8
RTC INTER-FACE U18-U19
AS
RTC CE
RTC E
RTC AS
PRINT
RTC R/W
RECORDER
CS2
E
RS
UART U3
R/W
S/D

FIGURE 1-12. GATEWAY PCB BLOCK DIAGRAM

Access to the data stored in EPROM U4 is obtained when: U6 has latched the low address byte, A8-A12 have stable address information, A13-A15 are all high and E is high. The data, previously addressed, is read into U1 on the falling edge of E.

1-57. Frequency Divider. A 15.625kHz clock signal is required to set the desired serial data baud rate for the ACIAs. The 1MHz E clock signal is divided by a factor of 64 in a 14 stage counter, U13, and fed to the receive/transmit clock inputs of U2 and U3.

1-58. Real Time Clock Interface. The real time clock (RTC) interface provides timing signals and chip enables for the RTC circuitry located on the Recorder PFC. These signals enable information to be exchanged between various circuits connected to the Gateway address/data bus.

Communication with the RTC is accomplished by using two successive instruction cycles. During the first cycle, the RTC is provided with an address where it will store or read data during the second instruction cycle. The data to be loaded represents time settings and other control data required for operation of the RTC.

The address cycle begins when U8, pin 13, goes low. This low is inverted by U16B and directed to AND gate U17B, pin 5. When E goes high, RTC Address Strobe (AS) is sent from U17B, pin 6, to the Recorder. RTC AS also resets U18A through U19B, providing RTC CE. (Note that U18A was set during power-on by $\overline{\text{RESET}}$.) U1 sends out a $\overline{\text{WRITE}}$ command that enables the RTC to latch the low address information on the trailing edge of RTC AS.

The data cycle begins when U8, pin 12, goes low. A high from the inverter, U16A, cause the output of U17A to go high. This high is applied to the Recorder as RTC E. During this time, RTC CE is high, so depending upon RTC R/$\overline{\text{W}}$, data will either be read from or written to the RTC. The RTC E signal is inverted by U16D which sets U18B, pin 11, high. When the next U1 address strobe (AS) occurs, U19C, pin 8, goes low; U17C goes low which in turn sets U18A and pulls RTC CE low. The low output from U18A, pin 14, is fed back to U18B, pin 8, forcing the flip-flop to be reset awaiting the next RTC access cycle.

The RTC is updated by microprocessor U1 when the TIME MODE SW pulls J1, pin 16A, low. At this time, a prompt appears on the CRT indicating which clock information is to be changed (hours, minutes, day, month and year). Depressing the TIME SET switch causes the displayed prompt to

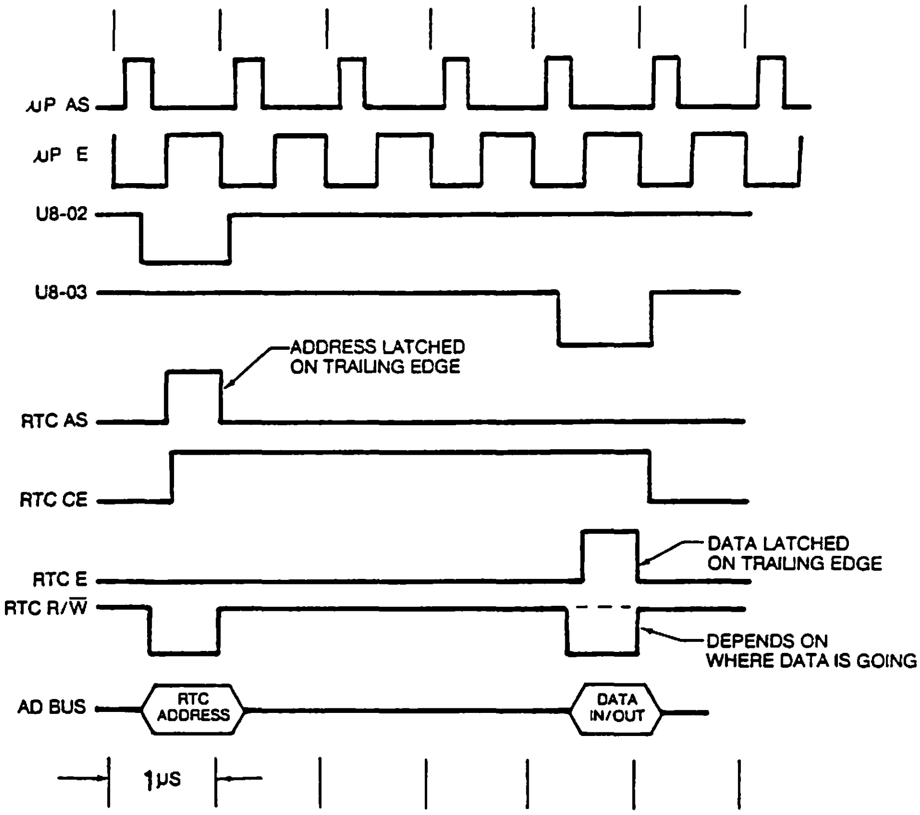
µP AS
µP E
U8-02
U8-03
ADDRESS LATCHED ON TRAILING EDGE
RTC AS
RTC CE
DATA LATCHED ON TRAILING EDGE
RTC E
RTC R/W̄
DEPENDS ON WHERE DATA IS GOING
AD BUS
RTC ADDRESS
DATA IN/OUT
1µs

FIGURE 1-13. RTC INTERFACE TIMING

scroll through all combinations appropriate for that clock function (e.g., the months will advance). Upon release of the TIME SET switch, the RTC is loaded with the updated information and allowed to operate normally.

Successive depressions of the TIME MODE switch will allow the operator to update other RTC registers. Once a complete update has been performed, the CRT prompt is removed.

1-59. Printer Message Format. The Recorder printer uses codes prepared on the Gateway PCB to reconstruct alphanumeric characters. These characters are printed in a five by seven dot matrix. Since the print head can only make one vertical column of seven dots at a time, the Gateway must provide the proper dot patterns, in sequence, for the message to be written.

The EPROM, U4, contains all of the dot patterns for the LP 8 messages. This memory is arranged so that all five columns for a character are stored in successive locations. Complete words and messages are stored in a similar manner. The microprocessor U1 needs only to look up the bit pattern and send it, along with PRINT, to the printer latch (on the Recorder PFC). Printer message formatting is accomplished through a software routine.

Once U1 has retrieved a bit pattern and placed it in internal buffer, it will address the printer latch, forcing U8, pin 14, low. This low is inverted by U16C and NANDed with E; PRINT goes low. When E is high, the bit pattern is available on the data bus. PRINT goes high at the end of the E period and causes the bit pattern to be latched by the printer.

The speed at which the Recorder operates will determine how often the printer is updated with a new pattern, the printer is updated every 6ms for 50mm/sec and every 12ms for 25mm/sec speeds.

1-60. External Communication. Serial communication between the LP 8 and external devices is controlled by the Gateway PCB. General purpose asynchronous communication interface adapter circuits (ACIA), U2 and U3, act as translators between the Gateway parallel data bus and external equipment. These devices operate under control of the U1 software. The ACIAs are addressed by U8, pins 9 and 10, when either of these pins go low. Other U1 control lines, R/$\overline{W}$, E, and RS are also necessary to direct operation of U2 and U3. The DIP switches S1-1 through S1-8 are used for signature analysis and should be in the open position for normal Gateway operation.

The operational cycle begins with initialization of the ACIA. The control register is loaded with data from U1 on the trailing edge of E when U8, pin 9, (low any time U2 is enabled), RS and R/$\overline{W}$ are low. The device is now ready for operation. Transmission of a character begins when data is written into the transmit data register on the falling edge of E when RS is high and R/$\overline{W}$ is low. All other transmit operations are handled by the ACIA automatically. Characters are received and stripped of start/stop bits automatically. The microprocessor checks the status register to see if anything new has arrived. If so, a read cycle is initiated and the contents of the receive data register may be sent to the microprocessor. Note that receive data register contents are not destroyed by a read.

In the LP 8, a baud rate of 976 has been selected (976 bits/sec). The ten bit serial word length is divided into one start bit, eight data bits and a stop bit. No parity is used. If any errors are detected, during serial data transmission, incorrect characters will be ignored and corrected during successive serial packets.

Each of the ACIAs is responsible for communication with a different peripheral device. The Central Monitor System (CMS) is interfaced through U2; ACIA U3 is provided for future expansion of the system. The CMS serial interface operates on ± 15V logic. For this reason, U11A is set up as level shifter to convert 0 to +5V logic from U3 to a usable amplitude. When serial data is received, U11B and U14C reverse this level shift for use by U2. CR3 and CR4 provide static protection for these serial lines.

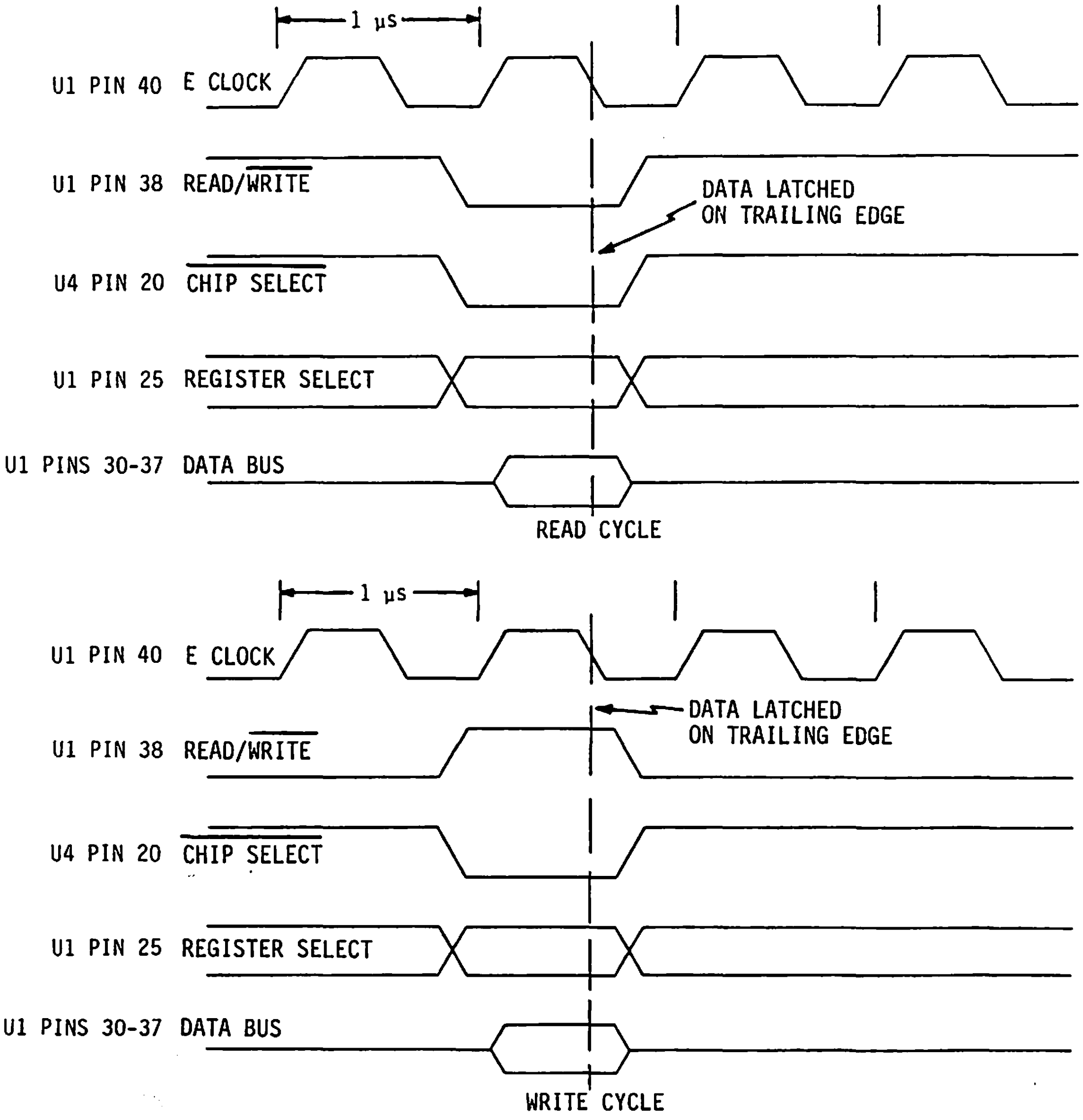
1 µs
U1 PIN 40 E CLOCK
U1 PIN 38 READ/WRITE
DATA LATCHED ON TRAILING EDGE
U4 PIN 20 CHIP SELECT
U1 PIN 25 REGISTER SELECT
U1 PINS 30-37 DATA BUS
READ CYCLE
1 µs
U1 PIN 40 E CLOCK
DATA LATCHED ON TRAILING EDGE
U1 PIN 38 READ/WRITE
U4 PIN 20 CHIP SELECT
U1 PIN 25 REGISTER SELECT
U1 PINS 30-37 DATA BUS
WRITE CYCLE

FIGURE 1-14. ACIA WRITE CYCLE TIMING

1-61. CRT PCB ASSEMBLY (802831).

The CRT PCB (see Figures 1-15 and 5-14) incorporates all the analog driver circuitry necessary to support the hybrid analog trace and the alphanumeric display. The PCB's four major functions are horizontal deflection, vertical deflection, intensity control, and voltage reference. Timing signals and the analog display signal are provided by the Control PCB.

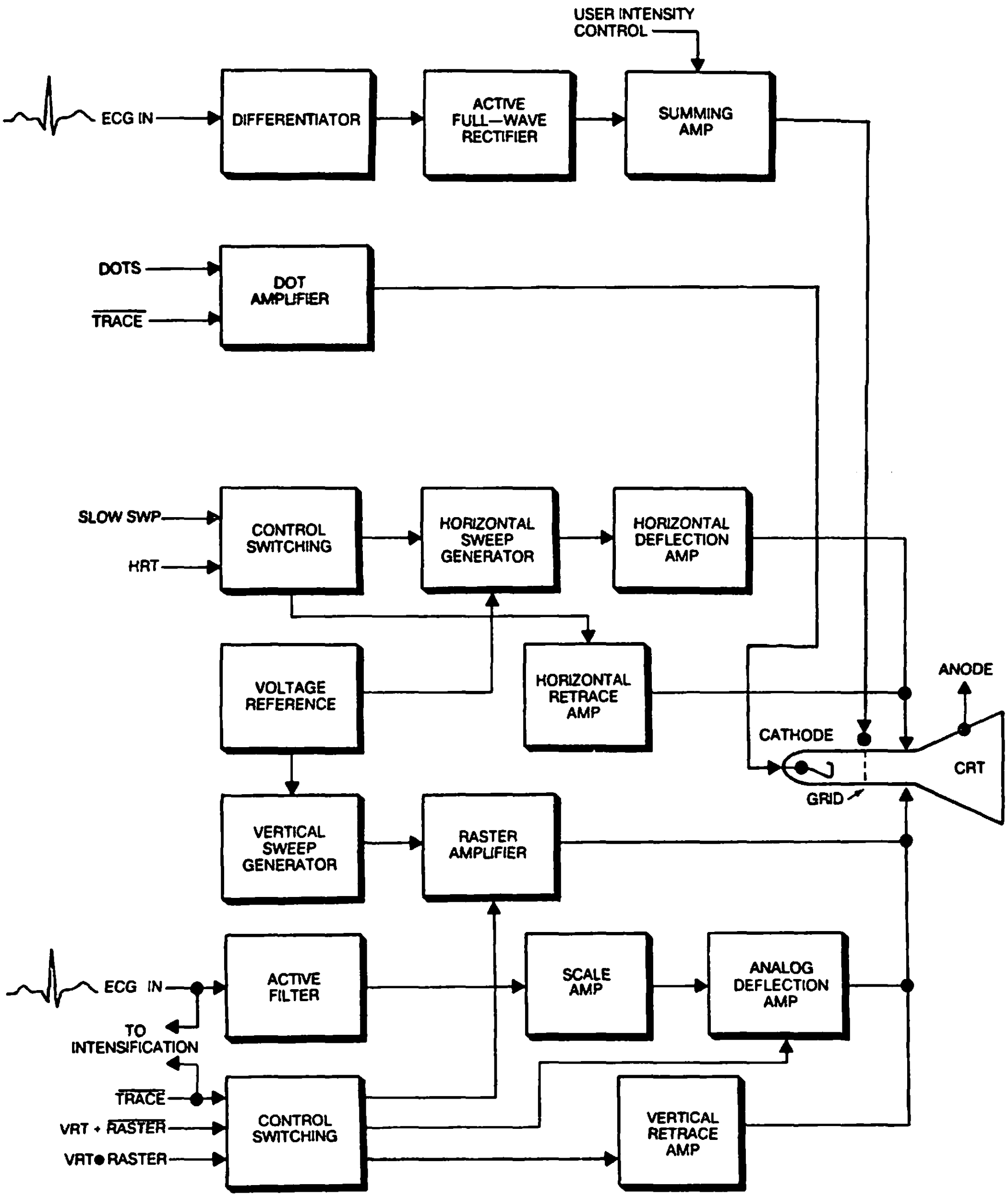
USER INTENSITY CONTROL
ECG IN
DIFFERENTIATOR
ACTIVE FULL—WAVE RECTIFIER
SUMMING AMP
DOTS
TRACE
DOT AMPLIFIER
SLOW SWP
HRT
CONTROL SWITCHING
HORIZONTAL SWEEP GENERATOR
HORIZONTAL DEFLECTION AMP
VOLTAGE REFERENCE
HORIZONTAL RETRACE AMP
ANODE
CATHODE
CRT
GRID
VERTICAL SWEEP GENERATOR
RASTER AMPLIFIER
ECG IN
ACTIVE FILTER
SCALE AMP
ANALOG DEFLECTION AMP
TO INTENSIFICATION
TRACE
VRT + RASTER
VRT• RASTER
CONTROL SWITCHING
VERTICAL RETRACE AMP

FIGURE 1-15. CRT PCB BLOCK DIAGRAM

1-62. Horizontal Deflection. The horizontal deflection circuitry provides beam deflection at two rates, one for analog trace display and the other, a reduced rate, for raster formation.

The sequence of events during one 20ms display cycle is as follows: for 5ms the beam moves from left to right across the CRT providing an ECG trace. Next is a 1.25ms horizontal retrace and beam positioning period. Following that, 7.6ms are used for raster construction during which the beam is deflected about one quarter of the way across the CRT, from left to right at about 1/9 of its ECG trace speed. During this time the intensity is modulated by the DOTS signal to display the alphanumeric information. After completion of raster construction the beam is blanked and swept to the right at normal ECG trace speed across the remainder of the CRT. There is a 1.54ms second horizontal retrace and beam positioning period and then the cycle begins again.

The timing of this cycle is controlled by two digital signals, HRT and SLOW SWP. These signals drive U2, which contains three two-to-one multiplexers. Multiplexers X (U2, pin 14) and Z (U2, pin 4) perform current steering functions for the sweep generator, U1, while multiplexer Y (U2, pin 15) acts as an inverter driving the sweep generator reset transistor, Q1.

1-63. Horizontal Sweep Generator. The sweep generator, U1 and associated components, provides the drive signal for the horizontal deflection circuit. U1A is configured as an inverting integrator. When SLOW SWP is low, input X0 of U2 is switched to output X, allowing current to flow from the positive reference through RN8 and R3. This current enters the summing node of the integrator. Alternatively, when SLOW SWP is high, input X1 of U2 is switched to output X, allowing current to flow from the positive reference through RN8 and R5 into the summing node of the integrator. These currents cause the output voltage of U1A to ramp negatively at rates dependent on the settings of R3 and R5. As a result, R3, which allows a larger current to flow, determines the sweep rate during trace. Similarly, R5, which controls a smaller current flow, determines character width during raster scan.

During the interval when HRT is high, the Y output of U2 floats, allowing RN8 to pull the gate of Q1 to ground. Q1 turns on, discharging C3, which effectively resets the integrator. When HRT is low, the gate of Q1 is pulled to +5V, causing the FET to turn off and allowing the integrator to function. Diodes CR22 to CR25 act as clamps to limit the differential input voltages to U1A and U1B.

U1B performs two functions related to sweep generation. It provides an offset which determines the horizontal position of the trace or characters, and it also provides a linearity correction.

When SLOW SWP is low, current flows from the positive reference U1D through RN8 and R14 to the Z output of U2 and into the summing node of U1B. A high SLOW SWP signal causes current to flow from the positive reference through RN8 and R13 to to the Z output. Consequently R13 determines raster character horizontal position and R14 determines ECG trace horizontal position.

A yoke current change of 1mA at the edge of the CRT face causes greater deflection than a 1mA change at the center of the CRT face. To compensate for this effect, the gain of U1B is made to decrease by approximately 12% for large outputs from U1A. The point at which the gain decrease occurs is determined by the reference voltage (from U1C), CR1, CR2, and the ratio of the 249k and 69.8k resistors of RN8. The magnitude of the gain reduction is controlled by the ratio of the 69.8K resistor of RN8 and the 10K feedback resistor of RN1.

1-64. Horizontal Deflection Amplifier. The sweep signal at the output of U1B is applied to the horizontal deflection amplifier. This amplifier consists of U3, and the current boosting transistors, Q2 and Q3. The amplifier is an inverting transconductance amplifier producing a negative output current proportional to the input voltage. The output current is sensed by R22. Feedback through R19 causes the deflection amplifier to adjust its output so that the sensed voltage at R22 is proportional to the input voltage. Transistors Q2 and Q3 are driven by signals derived from the supply current of U3. If the output of U3 is zero, no current flows through R17 and the only current drawn from the power supplies is the quiescent current of U3. Under these conditions resistors R16 and R17 have approximately 400mV across them. If, for example, the output of U3 goes positive, additional current flows from the +5V supply through R16, U3, and R17 to ground. This current increases the voltage drop across R16, increasing the base to emitter voltage of Q2. For sufficiently large currents, Q2 turns on, delivering current to the load. Conversely when the output of U3 swings sufficiently negative, Q3 turns on. Note that any current in excess of the quiescent current flows from one supply to ground and not between supplies. This prevents both current boosting transistors from turning on simultaneously.

1-65. Horizontal Retracer Amplifier. During horizontal retrace, it is necessary to reposition the beam quickly to the left side of the CRT. The horizontal deflection amplifier, powered by the +5V supply, is unable to drive the large horizontal yoke inductance fast enough. In order to accelerate horizontal retrace, a retrace amplifier is employed.

This switchable current source consists of R20 and Q4, and is controlled by HRT through Q5. When HRT goes high, Q5 turns on, driving the base of Q4 low and producing a voltage across R20. This determines magnitude of the retrace current source. CR4 in deflection amplifier prevents current from entering the +5V supply instead of the yoke.

When yoke current is less than that required at the end of horizontal retrace, the deflection amplifier is saturated trying to drive more current through the yoke. At some point the yoke voltage drops low enough so that the deflection amplifier can supply current to the yoke in addition to that supplied by the retrace amplifier. The deflection amplifier adjusts this additional current through its feedback until the proper current is achieved.

At the end of horizontal retrace, HRT goes low turning Q5 and Q4 off. At this point, the deflection amplifier begins to supply the entire yoke current, which is proportional to its input voltage.

1-66. Vertical Deflection. The vertical deflection system produces a series of raster lines as well as a reconstruction of an analog signal.

A typical display cycle proceeds as follows. During the horizontal retrace time, all amplifier outputs of the vertical deflection system are inactive. At the beginning of trace, the output driver of the analog deflection amp is enabled, remaining active for the 5ms trace time. As the horizontal sweep is from left to right, the reconstructed analog signal is presented to the analog deflection amp in chronological order. During the next horizontal retrace period, the vertical deflection system outputs are again inactive. At the start of the 7.6ms raster period, the vertical retrace amplifier is active for 30μs, pulling the beam to the top of the CRT. A scan line is then generated by enabling the output of the raster amplifier for 150ms. This cycle of retrace and scan line generation is repeated 42 times during the raster time, allowing 6 columns of 7 scan lines each. Again during the 5ms inactive period of the display, the vertical deflection system is inactive as a power conservation measure.

1-67. Vertical Sweep Generator. Unlike the horizontal deflection system, in which the sweep is controlled by a transconductance amplifier, the vertical deflection system uses a current source to determine the initial point of a raster sweep in an open loop configuration.

U5A is configured as a proportional-integral controller, with a constant current derived from the negative reference through RN7 and potentiometer, R52. This current, flowing through C12, is integrated to form a ramp. The current also flows through the 576 ohm resistor of RN7 resulting in a ramp with a constant offset present at the output of U5A. Controller U5A is reset every vertical retrace time by the VRT+$\overline{\text{RASTER}}$ signal turning on Q10, which discharges C12.

1-68. Raster Amplifier. After C12 has been discharged, the offset ramp from U5A drives the inverting power amplifier composed of U5B, Q26 through 28, and Q15 and 16. When VRT+$\overline{\text{RASTER}}$ is low, switching transistors Q11 and Q12 are off, allowing the gates of MOSFETs Q13 and Q14 to be pulled high. In this state, MOSFETs Q13 and Q14 conduct, allowing Q26 and Q27 to drive the power amplifier output transistors Q15 and Q16. This results in the amplified offset ramp being applied to the yoke winding at J2 pins 3 and 4. Due to the switching of the amplifier, the offset appears to the yoke to be a step in voltage, providing the requisite waveform at the yoke for a nearly linear current ramp. During the interval when VRT+$\overline{\text{RASTER}}$ is high, the MOSFETs are off, isolating the bases of Q15 and Q16, and preventing any conduction through them. The diodes CR12 and CR13 prevent yoke voltages greater than the supply voltages of Q15 and Q16 from causing operation in the reverse active region.

Note that the positive supply for the power output stage of the raster amplifier is ground. This is possible since the drive voltage to the yoke is guaranteed to be negative. In effect the yoke inductance is being discharged through Q15.

Q26 through Q28 are simply a current booster for U5B, to assist in driving the relatively low beta power transistors. Q28 provide a constant bias of approximately 1.6 diode drops between the bases of Q26 and Q27. With the 20 ohm emitter resistors of RN4, this bias method reduces crossover distortion without danger of thermal runaway.

1-69. Vertical Retrace Amplifier. Vertical retrace is controlled by the RASTER•VRT signal, which enables the retrace current amplifier only during the retrace portion of the raster period. When RASTER•VRT is high, Q17 conducts; this allows CR11 to maintain a constant voltage across Q18, R46, and R45. This produces a constant current flow from the collector of Q19 into the vertical winding of the yoke, stabilizing the vertical retrace. The amount of current is set by R46, the character height adjustment. Since the current is derived directly from the +20V supply, a large voltage can be applied to the yoke inductance producing a rapid retrace. At the end of the vertical retrace period, RASTER•VRT goes low, turning Q17 off and disabling the current source prior to the next scan line sweep.

1-70. ECG Active Filter. The reconstructed analog signal to be displayed is applied to an inverting buffer/active filter consisting of U9A, RN7, C104 and C105. Configured as the second stage of a 37kHz, 4 pole Butterworth filter, this circuit removes any high frequency noise. The filtered signal is then applied to U9B where final gain is set by adjusting R68.

1-71. Analog Deflection Amplifier. The power amplifier formed by U8, Q40 through Q42, Q24, and Q25 is similar to the raster amplifier. Here the voltages supplying the power output stage are +15V and -15V rather than 0V and -6V. The larger supply voltages provide the slew rate required to reproduce ECG waveforms accurately.

The reconstructed analog signal then drives the noninverting transconductance amplifier composed of U8, and Q40 through Q42, and Q24 and Q25. When $\overline{\mathrm{TRACE}}$ is low, switching transistors Q20 and Q21 are off, allowing the gates of MOSFETs Q22 and Q23 to be pulled high. The power amplifier output stage is then driven by Q40 through Q42 through the on MOSFETs. This results in the yoke winding being driven by the raster amplifier. Since the amplifier feedback is taken from the yoke current sensing resistor, R76, the current through the yoke is proportional to the reconstructed analog signal. During the interval when $\overline{\mathrm{TRACE}}$ is high, the MOSFETs are off, isolating the bases of Q24 and Q25, and preventing any conduction through them. Diodes CR17 prevents yoke voltages greater than the supply voltages of Q25 from causing operation in the reverse active region.

Q40 through Q42 provide current booster for U8, to aid in driving the relatively low beta power transistors Q24 and Q25. Q41 provides a constant bias of approximately 1.6 diode drops between the bases of Q40 and Q42. With the 20 ohm emitter resistors of RN5, this bias method reduces crossover distortion without danger of thermal runaway.

1-72. Power Saver. When the Monitor is turned on, the vertical deflection circuitry could present a heavy load to the power supply before the supply voltages have stabilized. This load would increase the time required by the supply to achieve a stable output, and cause the switching frequency to drop into the audible range as the supply attempted to supply the heavy load. Consequently, a soft start circuit disables the vertical deflection system until the supplies are stable.

This circuit consists of Q32 through Q34, C103, CR26 and CR27, R114 and three resistors in RN6. From a cold start, C103 is discharged. As a result any increase in the supply voltages as the power supply is energized appears across R114 as C103 begins to charge. Since the MOSFETs used for Q32 through Q34 have a low threshold, they are quickly turned on by the voltage across R114. Q33 actively pulls the gates of Q13 and Q14 to the -15V rail. This is the lowest voltage in the circuit at all times. The result is that Q13 and Q14 are held off disabling the power output stage of the raster amplifier. Similarly, Q34 pulls the gates of Q22 and Q23 to -15V to disable the analog deflection amplifier output.

Q32 holds Q17 off by pulling its base toward -15V, but in order to prevent reverse breakdown of Q17's base-emitter junction, the two resistors of RN6 are scaled to limit the base voltage to greater than -2V.

CR27 and the 4.7K resistor of RN6 function as a simple voltage regulator. This prevents small drops in the supply lines from causing the soft start to cut in. CR26 rapidly discharges C103 when the supplies actually disappear, allowing the soft start to function in the case of rapidly cycled power.

1-73. Rate Intensity Compensation. The LP 8 intensity control system provides independent control of the ECG trace and alphanumeric intensities, blanking, a user accessible intensity control and rate intensity compensation. This last feature causes the intensity to modulate during an analog trace to compensate for increased beam speed during transients like R waves. Intensity modulation in this manner allows operation at low average beam currents, resulting in longer phosphor life.

Providing all of these features requires modulation of the voltages on both the CRT control grid and cathode. The actual beam current and intensity depend on the difference in potential applied to these electrodes. As the grid is made more negative with respect to the cathode, the beam current decreases.

The dc level on the grid is set by a resistive divider consisting of R33 and a rear panel potentiometer, CRT BRIGHT. This potentiometer allows the user to control the grid bias, directly affecting overall intensity. The impedance the divider presents to the grid is stable regardless of potentiometer setting due to the series impedance of R32. This allows ac coupling of other signals to the grid without attenuation.

Rate intensity compensation is controlled by U4. The process consists of, differentiating the analog display signal to extract rate information, full wave rectification to obtain the absolute value of the rate, and final amplification of the compensation signal.

U4A is configured by RN2 and C10 as a differentiator whose output is proportional to the rate of change of the input. Since the differentiator's gain increases with frequency, it is prone to oscillation. R27 and C11 provides limits to U4A's gain at high frequency to prevent oscillation and limit the noise bandwidth.

Half wave rectification is provided by U48, whose output is taken from the anode of CR8. At this point the gain is -1V if the input is positive; the output is zero if the input is negative, since no current flows from the inverting terminal of U4B through CR8 and RN2.

Two functions are performed by U4C. First it provides summation of the output of the differentiator and the scaled output of the half wave rectifier; second it provides overall gain of the compensation signal. Configured as an inverting amplifier, U4C's inverting intput acts as a current summing node. Since the resistance connecting the half wave rectifier to the summing node is one half that connecting the differentiator to the summing node, U4C effectively adds twice the half wave rectifier output to the differentiator output. The input to U4C is therefore a full wave rectified rate compensation signal. U4C subjects this input to its inverting gain, which is adjustable through R36, and ac couples the final compensation signal to the grid through C8.

The analog trace signal is applied to the rate compensation circuitry at all times. As a result, it would be possible to have rate compensation occur when there is no trace displayed. To prevent this, Q31 is controlled by the $\overline{\text{TRACE}}$ signal. When $\overline{\text{TRACE}}$ is high the display is not in trace mode, and Q31 turns on, forcing the gain of the rate compensation circuit to zero.

1-74. Dot Amplifier. The dot amplifier performs blanking and dot driver function through the cathode electrode of the CRT. Control of this amplifier is accomplished through the $\overline{\text{TRACE}}$ and DOTS signals. When $\overline{\text{TRACE}}$ is low, Q9 is held off, forcing Q8 off as its gate is pulled high by R37. During trace time, when the DOTS signal is low, R29 holds Q7 off. Therefore the cathode is held to a dc potential by a relatively high resistance divider consisting of R39 and potentiometer R40. By adjusting R40, the trace baseline intensity can be varied. CR41 guards against variations in intensity due to power supply loading. Q43 blanks the CRT beam immediately as power is turned off.

It is possible for the DOTS signal to go high during the ECG trace period. This occurs during a sync marker. When DOTS goes high, Q7 turns on, pulling the cathode toward ground potential. The result is a very intense, defocused spot which serves as a sync mark.

At the end of the trace period, $\overline{\text{TRACE}}$ goes high, turning on Q9 and Q8. With Q8 on, a low impedance path exists from the +60V supply to the cathode in parallel to the high resistance divider. This pulls the cathode to approximately +60V, blanking the trace.

During the raster period, the DOTS input goes high and is capacitively coupled to the gate of Q7. The capacitive coupling prevents continuous turn on of Q7, which would lead to excessive power consumption. When Q7 turns on in response to the DOTS signal, it pulls one end of a low impedance divider formed by R30 and R31 to ground. The resulting voltage applied to the cathode is determined solely by this divider, as its impedance is much lower than that of the trace intensity control divider. This allows control of alphanumeric intensity through potentiometer R31. An additional benefit of the low impedance of the divider is that the response time is fast enough to prevent blurring of the dots due to slow rise and fall times.

1-75. Voltage References. The voltage reference outputs are bipolar and are used to provide a stable signal source for the generation of the horizontal and vertical sweeps. The positive reference also goes to the Anode Supply PCB.

CR3 is an LM329B reference diode which provides a highly stable voltage. The reference voltage is buffered by a pair of op amps, U1C and U1D. U1C is configured as an inverting amplifier with a gain of .5 to provide a reference of -3.45V. Since the inverting terminal of U1C is a virtual ground, the pair of input resistors form a divider from which the input of U1D is taken. Configured as a voltage follower, the output of U1D is the divided reference voltage, 3.45V.

1-76. ANODE SUPPLY PCB ASSEMBLY (802813).

The Anode Supply PCB (see Figures 1-16 and 5-15) provides the 9kV anode voltage and the 400V accelerator grid voltage required by the CRT. These voltages are produced by a voltage controlled oscillator (VCO) driving a flyback switching regulator. The VCC uses +5V and -6V supplies. Note therefore that the reference for the VCO, switching transistor, flyback transformer, and grid voltage regulator is -6V not ground.

1-77. Voltage Controlled Oscillator. The voltage controlled oscillator (VCO), U2, is a 555 timer configured as an astable multivibrator. U2 oscillates at a frequency determined by the values of R12, potentiometer R13, R14 and C5. The charging time constant is determined by R12 and C5. During this time, the voltage at U2 pins 2 and 6 is below approximately two-thirds of the supply voltage.

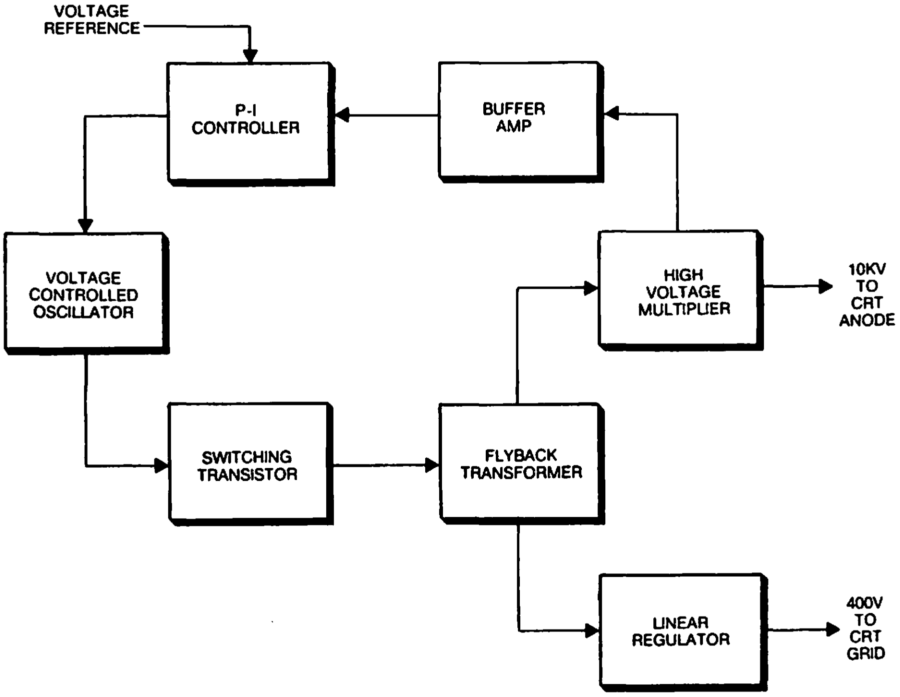
VOLTAGE REFERENCE
P-I CONTROLLER
BUFFER AMP
VOLTAGE CONTROLLED OSCILLATOR
HIGH VOLTAGE MULTIPLIER
10KV TO CRT ANODE
SWITCHING TRANSISTOR
FLYBACK TRANSFORMER
LINEAR REGULATOR
400V TO CRT GRID

FIGURE 1-16. ANODE SUPPLY PCB BLOCK DIAGRAM

Internal comparators detect this below-threshold condition, causing the output of U2 to go high. When the capacitor voltage reaches the upper threshold voltage, these comparators then change state, forcing the output, pin 3, low, as well as the discharge output, pin 7.

During a typical cycle, Q1 is turned on by the voltage applied to its base from R11. A discharge path then exists through Q1, R13 and R14. By adjusting R13, the off time of the oscillator can be controlled. The output of U2 remains low until the voltage at U2, pins 2 and 6, drops to approximately one-third of the supply voltage. The discharge pin is then allowed to float and current can again flow through R12 and CR5 to charge C5 starting a new cycle.

The VCO regulates output voltage through R1; the voltage at R1 is proportional to the sense voltage of M1 as the voltage on R1 increases above the level on timing capacitor C5, current flows through CR1 and R1 as well as the normal charging path through R12. Charge time therefore decreases proportionally to the voltage at R1. U2, pin 3, stays high for a shorter period resulting in less energy being transferred to the output.

The discharge path is unaffected directly by the voltage on R1 so the off time of the oscillator remains the same. The frequency of oscillation, therefore, changes as the on time changes.

1-78. Power Switching. The output of the VCO drives the power MOSFET Q2. When the VCO output is high, Q2 is turned on hard, allowing current to flow in the primary of T1, the flyback transformer. The supply voltage of 11V is applied across this primary inductance, resulting in an increasing current ramp through T1 and Q2. Since the VCO modulates the on time of Q2, the energy stored in T1, during a cycle, is also modulated.

When the VCO output switches to its low state, Q2 is suddenly turned off. The energy stored in the primary of T1 is then transferred to the secondary where a high voltage, low current pulse is produced. This output pulse is the voltage source for the output regulator and voltage multiplier.

During this flyback period when current flows through the secondary, CR9 is forward biased, clamping T1, pin 6 to approximately -6.6V. R11 keeps the anode of CR6 pulled high and CR6 begins to conduct, clamping the base of Q1 to -6V. Q1 is then turned off while current is flowing in the transformer secondary. C5 has no discharge path as long as Q1 is off. This dead time in the VCO cycle guarantees maximum energy transfer to the secondary thus increasing efficiency.

The off time adjustment provided by potentiometer R13 is used to trim the waveform at the drain of Q2. If the dead time is misadjusted, the resonant circuit formed by C11 and the primary inductance of T1 causes the voltage at the drain of Q2 to rise during the on period. R13 should be adjusted (with the output at its nominal level) to eliminate this voltage rise.

The soft start network consisting of CR7, C7, R15, and R16 prevents overstressing Q2 at turn on. The RC time constant prevents the gate of Q2 from reaching +5V during the first few VCO cycles. Q2 does not turn on fully thus limiting the initial current flow. This is necessary since the zero output voltage at start up causes the VCO to run at maximum duty cycle.

1-79. Grid Voltage Regulation. CR10 is a high voltage rectifier which converts the output pulses of T1, pin 5, into a regulated dc voltage on the filter cap C9. This dc level is then more tightly regulated by the passive network R18, R19, CR11 and CR12. Filtering is provided by C10. R20 and R21 provide a relatively low power dissipation bleed resistance for the output filter.

1-80. Anode Voltage Regulation. T1, pin 4, is tied directly to a voltage multiplier, M1, which boosts the output voltage by a factor of eight. R9 divides the sense output of M1 by 1000. C4 reduces high frequency components of the signal which is then buffered and inverted by U1B. R6 adjusts amplifier gain. U1A then integrates the difference between U1B output and a reference voltage and provides the control voltage to the VCO through R1.

When the error between the scaled output voltage and reference voltage is reduced to zero, the integrating nature of the controller maintains the proper control voltage at R1. The series resistance, R2, in the feedback path of U1A provides a signal that is directly proportional to the error voltage. This decreases the time required to respond to transients on the output voltage. C1 provides control loop frequency compensation in combination with R2 and the integrator capacitor C2.

1-81. RECORDER PFC ASSEMBLY (802819).

The LIFEPAK 8 has been designated to be used with a record from one of two manufacturers, MFE and GSI. For this reason, two different recorder PFCs have been designed (see Figures 1-13, 5-16A, and 5-16B). These flex assemblies have several identical circuits but some circuits are completely different. To avoid redundancy, the paragraphs will be labeled to show whether the description applies to the MFE, the FSI or BOTH recorder assemblies. NOTE: when circuitry is common for both recorders, component designations, if different, will be given for the MFE recorder first with the corresponding GSI comonents listed in parentheses.

The annotating Recorder is used to provide a diagnostic hard copy of a patient's ECG waveform. A string of five by seven dot matrix characters may also be printed in the upper margin of the recorder paper. This annotating feature provides data relevant to alarms, time, heart rate, QUIK PACE and Defibrillator performance. Refer to Figure 1-17, Recorder PFC Block Diagram and Figure 5-16, Recorder PFC Assembly.

1-82. Recorder On/Off (Both). Recorder power is activated by the Control PCB when the RECORDER $\overline{\text{ON}}$/OFF line, J1-B7, is pulled low. This low passes through R1 (R14) to the base of Q3 (Q7) turns the transistor on and forces its collector to +5V. The +5V turns on Q4 (Q6), passing -15V to the collector for use as -15V SW SOURCE. The +5V is also supplied to the base of Q5 (Q8), pulling the collector to ground. This turns on Q6 (Q5) and passes +15V power to its collector for use as +15V SW SOURCE. A +5V SW SOURCE is developed replaces 1-82 regulated by the zener diode U13 (CR6 and R13).

1-83. Real Time Clock . The Real Time Clock (RTC) provides time of day and calendar information to the Gateway PCB for use in the LIFEPAK 8 system. A single chip RTC carries out all time keeping functions, powered at all times by standby power or by a back-up lithium battery (not on Recorder PFC Assembly). CR5 (CR9) protects the battery during normal operation when the RTC is powered by STDBY PWR.

The RTC, U8, is addressable like any other memory location connected to the Gateway address/data bus. Additional information about RTC operation may be found in paragraph 1-58, Real Time Clock Interface, of the Gateway PCB circuit description.

A low power crystal oscillator, U9, provides a 32.768kHz time base for the clock. When power is removed from the Monitor, Q9 turns off and forces CE high to isolate the clock from the address/data bus.

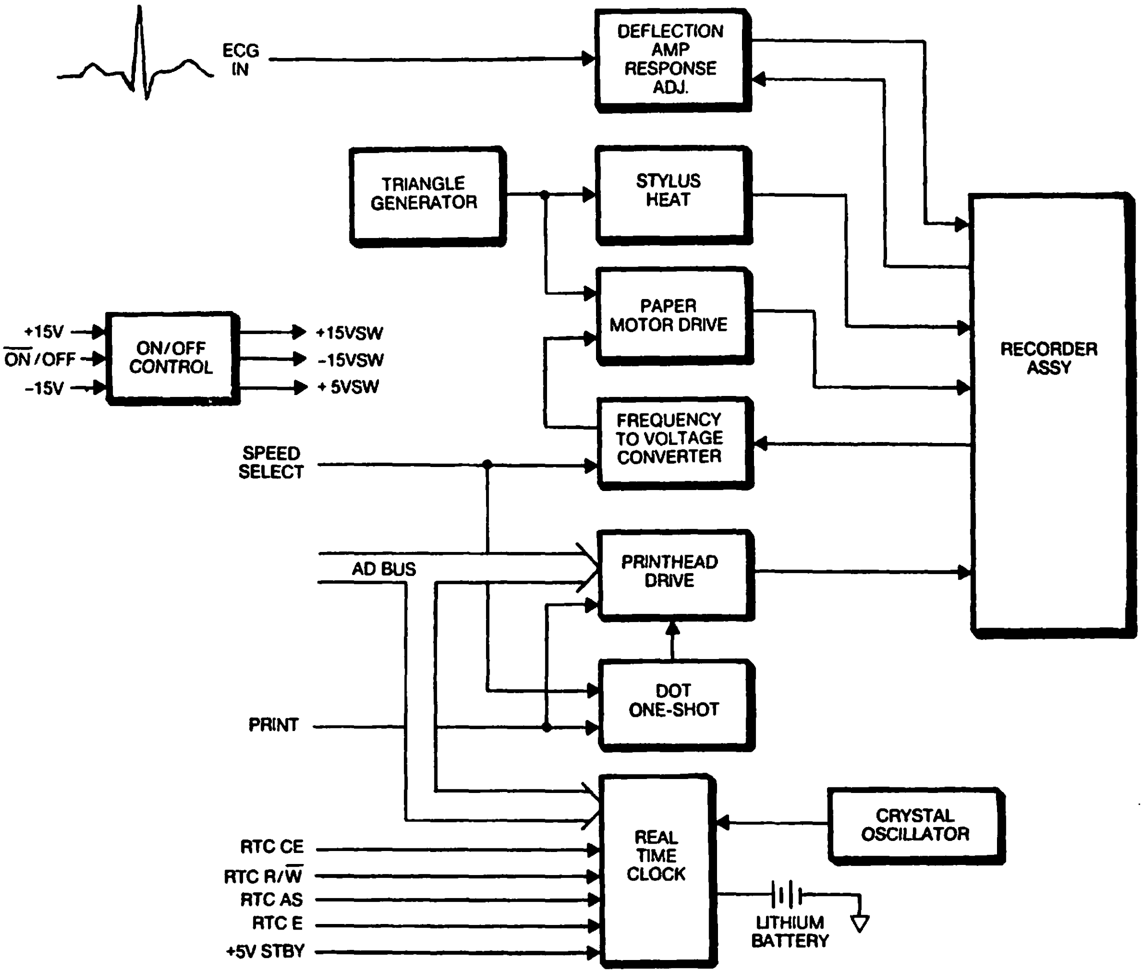
ECG IN
DEFLECTION AMP RESPONSE ADJ.
TRIANGLE GENERATOR
STYLUS HEAT
+15V
ON/OFF
-15V
ON/OFF CONTROL
+15VSW
-15VSW
+5VSW
PAPER MOTOR DRIVE
RECORDER ASSY
FREQUENCY TO VOLTAGE CONVERTER
SPEED SELECT
AD BUS
PRINTHEAD DRIVE
DOT ONE-SHOT
PRINT
REAL TIME CLOCK
CRYSTAL OSCILLATOR
RTC CE
RTC R/W
RTC AS
RTC E
+5V STBY
LITHIUM BATTERY

FIGURE 1-17. RECORDER PFC BLOCK DIAGRAM

1-84. Printhead Drive (Both). Characters are thermally printed on the Recorder in a five by seven matrix. Dot code data from the Gateway PCB is latched into U6 when PRINTHEAD ENABLE is pulsed low. The positive transition toggles the one-shot U11A. The pulse width of U11A is determined by SPEED SELECT and switch U5B. The $\overline{Q}$ output of U11A, pin 4, goes low enabling the outputs of U6 which drive the NPN transistor array, U7. The common side of the dot heat element is connected to +15V. Individual dots are heated when U7 provides a current path from ground.

The pulse width of U11A, pin 4, determines dot darkness and is controlled by an RC network consisting of C11 (C5), R12 (R6), and R10 (R3) or R11 (R4). Dot darkness is adjustable by varying R12 (R6). The analog switch, U5B, selects either R10 (R3) for a longer dot heat time for the 25mm/s paper speed, or R11 (R4) for a shorter dot heat time for the 50mm/s paper speed.

1-85. Pen Heat (Both). The stylus heat circuit consists of a triangle wave generator, a comparator and a current source. A quick heat circuit is also provided for Recorder turn on.

A 10kHz triangle waveform is generated by U2A (U2C) as it charges and discharges capacitor C9 (C13). The output of U2A (U2C) is +5V (+7.56V) when C9 is discharged. The capacitor charges until its voltage equals that on U2's noninverting input, about +4V (+6V) causing the output to go low. The noninverting input to U2A (U2C) is now +1.1V (+1.5V). The capacitor discharges to the new reference whereupon the U2 output is forced high. The cycle is now repeated.

The triangle wave is applied to comparator U2B (U2A). Since the other input to the comparator is a dc voltage, whose level is adjusted by R6 (R21), the output is a series of +15V square waves whose width is controlled by the dc input level. These outputs pulses turn Q7 (Q1) on (and off) which supplies current pulses to heat the stylus.

When the recorder is turned on, C10 (C14) is discharged which allows Q8 (Q2) to conduct temporarily pulling one end of the stylus to -15V. This quick-heat feature brings the stylus up to operating temperature in about 1 second. When C10 (C14) charges sufficiently, Q8 (Q2) turns off, clamping one end of the stylus to +.7V.

1-86. Paper Motor Drive (MFE Only). Paper motor speed is electronically controlled using feedback from a tachometer connected to the motor itself. Actual motor speed is converted to pulse information for application to the driver, Q10.

The tachometer produces a sine wave which is full wave rectified, by CR6 through CR9, and converted to narrow trigger pulses when outputed from comparator U2C, pin 1. When the speed control loop is stabilized (at the correct paper motor speed) U11B outputs a square wave with a 40% duty cycle. The pulse width is controlled by U5A and RC network RN1/C18. These pulses are integrated by C20.

The voltage at TP1 (C20) therefore has a dc component of 40% of the +5V reference with a ripple that triggers comparator U2D. The motor speed is adjusted by R18 which sets the trigger point for U2D. The output from U2D is a pulse width modulated square wave at twice the tachometer frequency. The pulse width increases if tachometer frequency decreases. Current to the motor is controlled through drive transistor Q10.

1-87. Paper Motor Drive (GSI Only). The GSI paper drive motor speed is controlled in much the same way as the MFE recorder. Tachometer pulses are converted to pulse width modulated drive for the motor.

A triangle wave, from C13, is applied to the noninverting input of U2B while a variable voltage reference is fed to the inverting input. The output, from U2B, pin 14, is a pulse width modulated signal used to drive the motor through Q4.

The variable voltage reference is derived from a frequency to voltage converter, U3. The tachometer provides a square wave whose frequency is proportional to paper speed. At a speed of 25mm/s the frequency is approximately 84kHz; at 50mm/s approximately 168kHz. These pulses drive a charge pump, in U3, which uses a constant current to charge C4. The current to C4 is mirrored at C17 and R32 where it is averaged and applied to an internal operational amplifier. A voltage, adjusted by R24 (for 25mm/sec speed) or R23 (for 50mm/sec speed), is used as a speed control. The variable voltage reference appears at U3-5. An increase in this voltage will result in an increase of motor speed.

1-88. Pen Deflection (MFE Only). The pen deflection circuitry translates electrical signals into mechanical motion. Provisions are made for gain adjustment, damping and minimizing distortion.

The bandwidth of the incoming ECG is boosted from 70 to 400Hz in U1A to compensate for the normally poor high frequency response of a galvanometer drive. Recorder ECG size is adjusted by R5. A class B amplifier, consisting of U1B, Q1 and Q2 with two feedback paths actually drives the pen deflection coil. Deflection current is sensed across R9, through R24, and applied as negative feedback to U1B, pin 9. Mechanical resonances of the pen motor and stylus are damped through U1C.

A bridge circuit is formed by the pen deflection coil, pen balance coil, RN5-7/8, R8 and RN4-7/10. From this, U1C extracts the velocity-dependent back EMF generated by the deflection coil from the superimposed drive signal. This signal is summed at U1B, pin 9. Distortion is minimized by adjusting R8. Square wave overshoot is damped by adjustment of R7.

1-89. Pen Deflection (GSI Only). The incoming ECG is buffered by U4A and given a high frequency boost by C7. Gain is adjusted through R1.

The output from U4A is clamped between ±5.7V at the junction of CR1 and CR2. U4B is configured as a unity gain inverting amplifier. Stylus deflection is limited to ±2cm. Centering of the stylus is accomplished by adjustment of precision voltage divider R2.

Power amplification for the galvanometer is provided by U1. A feedback signal from R25 is sent to U1. This signal is a composite of voltage applied to and current sensed through the pen deflection coil. R25 is adjusted for critical damping of the stylus resulting in a flat frequency response to 40Hz.

A velocity feedback coil, within the galvanometer, produces a feedback signal which is summed with the incoming ECG. Adjustment of R16 sets the high end frequency response to 100Hz.

1-90. Serial Data Communication.

For an explanation of how the Monitor communicates with the Defibrillator, see paragraph 1-4.

1-91. LP 8 DEFIBRILLATOR

Paragraphs 1-92 through 1-129 provide circuit descriptions for the Power Supply, Main, and Logic PCB Assemblies.

The Defibrillator Interconnect Diagram in Section 5 provides interconnection data for all subassemblies.

1-92. POWER SUPPLY PCB ASSEMBLY (802719).

The Defibrillator Power Supply PCB Assembly provides all power for the LIFEPAK 8 Defibrillator and Pacing Cassette as well as continuous battery charging when connected to ac mains. The speaker driver is also located on the Power Supply PCB. (See Figures 1-18 and 5-28.)

1-93. AC Line Power Conditioning. The Power Supply PCB will withstand line voltage transients up to 6kV. F2 and RV1 provide most of this protection by limiting the voltage presented to the input rectifier. RV1 is a metal oxide varistor which has a nonlinear resistance. This device normally presents a high impedance to the ac line. However, should the peak voltage exceed approximately 430V, the resistance drops rapidly, clamping the voltage to this level. Fuse F2 opens when it encounters a line voltage transient from a source with a low effective impedance.

When the Defibrillator is first plugged in, the rectifier and filter capacitors, C4 and C5, appear as short circuits to the line due to their low effective source resistance. If line voltage happens to be applied at the peak of its cycle, currents exceeding 100A can flow possibly damaging the bridge rectifier CR3. Power-on surge currents are limited primarily by the negative temperature coefficient thermistor RT1 and inductor L1. At room temperature, RT1 has a resistance of about 5 ohms. This and the effective series inductance of L1 limit the inrush current to safe levels. As the power supply operates, current flows through RT1, which results in a temperature rise. As the temperature rises, the resistance of RT1 drops until equilibrium is established. Having a lower operating resistance results in less wasted power during normal operation.

CR3, C4, and C5 rectify and filter line voltage. When configured for 230V operation, pins 5 and 7 of P15 are open. For 115V operation, pins 5 and 7 of P15 are shorted together with a rear panel switch, reconfiguring CR3, C4, and C5 as a voltage doubler. This results in a nominal 230Vdc supply for the power switching circuitry regardless of the operating mode. In either case, R2 and R3 serve to equalize the voltage on each capacitor, as well as providing a path for bleeding charge off the capacitors without a large decrease in efficiency.

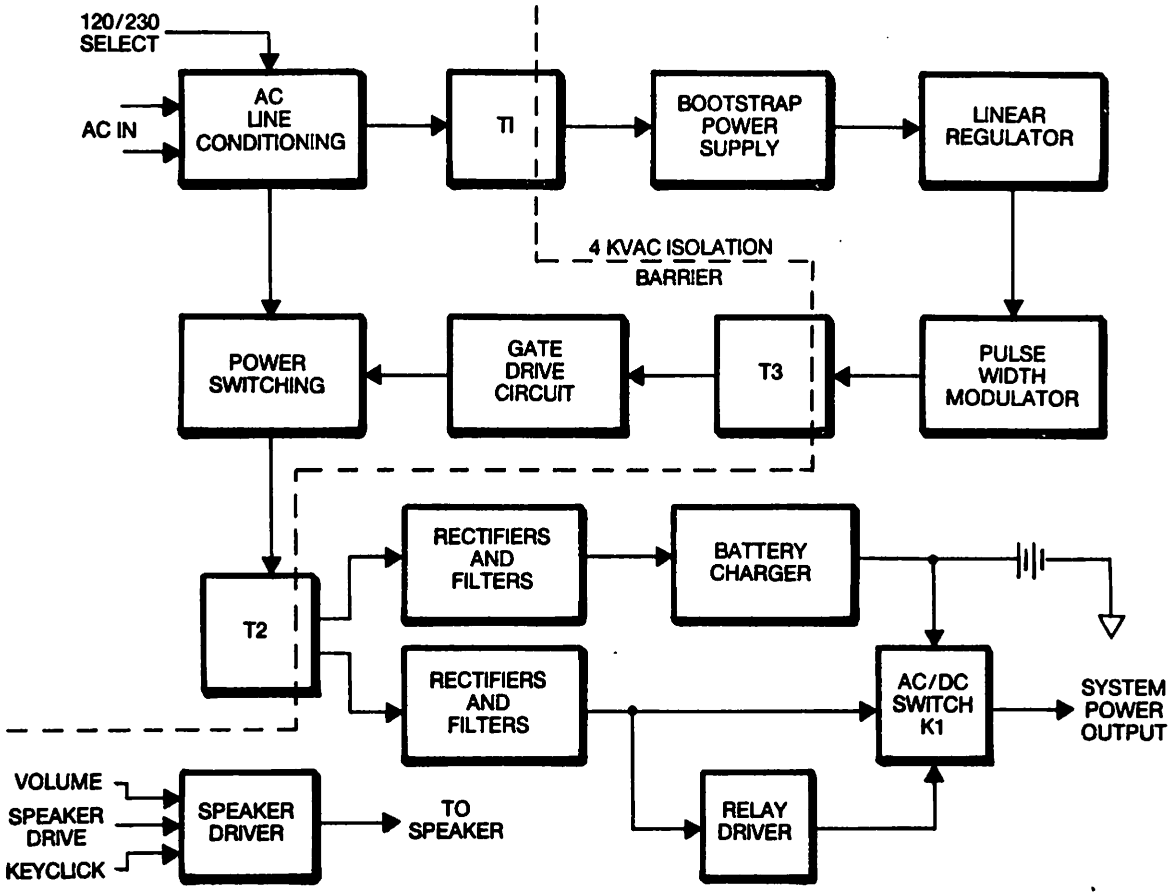
120/230 SELECT
AC IN
AC LINE CONDITIONING
T1
BOOTSTRAP POWER SUPPLY
LINEAR REGULATOR
4 KVAC ISOLATION BARRIER
POWER SWITCHING
GATE DRIVE CIRCUIT
T3
PULSE WIDTH MODULATOR
T2
RECTIFIERS AND FILTERS
BATTERY CHARGER
RECTIFIERS AND FILTERS
AC/DC SWITCH K1
SYSTEM POWER OUTPUT
VOLUME
SPEAKER DRIVE
KEYCLICK
SPEAKER DRIVER
TO SPEAKER
RELAY DRIVER

FIGURE 1-18. POWER SUPPLY PCB ASSEMBLY BLOCK DIAGRAM

Both the line rectifiers and the power switching circuitry can generate large amounts of high frequency noise. Conduction of this noise from ac mains connection must be limited. This filtering is provided by L1 to reduce the high frequency noise components without significant losses due to currents at the ac mains frequency.

1-94. Bootstrap Power Supply. The power switching control circuitry must be provided with supply power to start-up, otherwise switching cannot occur and no power will be delivered to the Defibrillator. In the power supply, an auxiliary low power linear supply operates in parallel to the switching power supply to provide all power for the control circuitry, not just that required at start-up.

T1 is an impedance limited transformer that provides power for the pulse width modulator, U1, across the 4kVac isolation barrier. Transient protection of the bootstrap supply is provided by parallel connection of the primary of T1 and RV1. The primary of T1 consists of a unswitched winding. The result is that regulation of the output over a wide range is required to allow operation from both 115Vac and 230Vac mains.

CR1 and C3 rectify and filter the output of T1, resulting in an output that varies between approximately +12V and +60V, depending upon actual ac mains voltage. Since the nominal bootstrap power supply voltage is +10V, the input to output drop at high line +230V exceeds the rating of monolithic regulators. Instead, CR27, R57, R61, Q10, and Q11 are configured as a regulator. The resistor and zener diode provide a reference voltage of +12V, which is buffered by the complementary Darlington formed by Q10 and Q11. The complementary Darlington configuration is used to minimize drop across the regulator when operating from low line +115V. C19 then provides output filtering of the bootstrap supply voltage.

1-95. Pulse Width Modulator. Control of the power switching circuitry is provided by an integrated circuit pulse width modulator (PWM), U1. U1 contains an oscillator, error amplifier, reference, PWM comparator, and drivers.

The basic oscillation frequency of the power switcher is set at 60kHz by C15 and RN1, pins 8 and 9, tied to U1, pin 6. A dead time of approximately 1% is set by R24. This resistor, in series with the discharge circuit, controls the reset time which must pass before a new oscillator cycle can begin.

The +5.1V reference is divided, by two, by RN1 and applied to the noninverting terminal of the error amplifier at U1, pin 2. The error amplifier calculates the difference between this voltage and the attenuated power supply output voltage applied to pin 1 through RN1. The amplified difference is applied internally to the PWM comparator, which controls the duty cycle of the driver transistors. The output of the error amplifier modulates the duty cycle so the voltages applied to the inverting and noninverting terminals of the error amplifier are the same. As a result, the +12V output is derived from the reference voltage and the ratio of the attenuation of the two dividers within RN1. The RC network formed by C12, C13 and RN1, pins 5 and 12, connected between U1, pins 1 and 9, provides frequency compensation of the power switcher as a whole.

Finally, C16, in conjunction with an on-chip current source, sets the soft start time constant. Soft starting the power switcher entails limiting the maximum duty cycle at start-up, to prevent overstressing the transistor switches as they drive the output filter capacitors in their discharged state. These capacitors appear as short circuits to the switcher at start-up due to their low effective source resistance.

The driver transistors in the PWM cannot directly drive the FETs, Q1 and Q2, which do the actual power handling, since the PWM lies on the isolated side of the 4kVac isolation barrier. Instead, the drivers alternately pull opposite ends of the primary of the gate drive transformer, T3, to ground. The result is a bipolar drive waveform applied to the gate drive circuitry on the non-isolated side of the barrier.

1-96. Power Switching. C4, C5, Q1, and Q2 form a half bridge converter, with the primary of the main power transformer (T2) connected across the bridge. Consequently, one end of the primary is always held at about 160V while the other end is alternately pulled to 320V by Q1 and 0V by Q2.

Driving the transistors in this manner requires a drive signal for Q1 which is derived from the source of Q1, which is constantly switching between +320V and 0V. The transformer coupling of the gate drive signal from U1 provides a method of accomplishing this level shifting by referencing one gate drive secondary to this point. Similarly, the correct reference for Q1 is achieved by referencing the other gate drive secondary to Q2's source.

The drive circuitry for Q1 and Q2 are identical so the following discussion will concern itself only with the drive for Q2.

As pin 5 of T3 becomes more positive, CR10 is forward biased and the gate capacitance of Q2 is charged through the series connection of CR10 and R7, rapidly turning the FET on. During the time the FET is on, it is driven by about +9V on its gate to achieve the lowest possible on resistance to minimize power losses. At the end of the on period, there is a short dead time when neither transistor is driven on. This is to guarantee that the Q1 and Q2 are never on simultaneously, which would short the input filter caps, draw large currents and damage the FETs. During this time, R5 discharges the gate capacitance of Q2, turning the FET off.

Short switching times are accomplished by Q4 and CR16 during turn off and the low resistance of R7 during turn on. When the voltage at the secondary of the gate drive transformer collapses at the start of the dead time, the gate capacitance of Q2 is still charged to about 9V. This holds the emitter of Q4 up, so the emitter-base junction of Q4 is turned on as the gate drive disappears. As Q4 turns on, the gate capacitance of Q2 is discharged more rapidly than if by R5 alone.

During the period of reverse drive, that is, when Q1 is on, the voltage appearing at pin 5 of the gate drive transformer is negative, holding Q4 on and a low impedance across the gate and source terminals of Q2. CR16 prevents the negative drive from forward biasing the collector base junction of Q4, which would steal gate drive from the other FET. CR8 and CR9 prevent overstressing the gate of Q2.

The primary of T2 is ac coupled through C6. This prevents net dc currents from flowing in the transformer which could cause core saturation. R13 and C18 absorb the energy stored each cycle in the primary leakage inductance.

1-97. Output Rectification and Filtering. Fuses F7 through F10 (or R63 and R64 for the -06) are provided to limit the amount of current drawn under shorted secondary conditions.

The main supply output is +12V at currents up to 10A during the Energy Storage Capacitor charge cycle. Nominal operating current exclusive of Energy Storage Capacitor charging is 500 milliamps. CR15 provides full wave rectification from a center tap secondary of T2 with these current capabilities. R12 and C17 reduce secondary leakage inductance. L2 and C11 form a nondissipative low-pass filter for ripple elimination on the regulated 12V supply. R27 and R28 provide a minimum load of 100mA.

CR12 and CR13 provide rectification for a low current auxiliary supply used for battery charging. C9 is connected to the +12V supply as a filter.

1-98. Battery Charger. Voltage regulator U3 is used as a constant current source to provide slow charge at a C/15 rate. U3 operates by maintaining 1.25V between pins 1 and 2. This voltage is applied across current setting resistor R10 to produce a 100mA charge current. C8 provides noise bypassing of the regulator adjustment terminal.

The charging current also flows through R11, where it produces a bias across the base-emitter junction of Q5. Whenever battery charging current flows, Q5 is on. This applies the +20V battery charge supply voltage to R9, allowing current to flow through the front panel BATTERY CHARGE LED.

1-99. AC/Battery Operation Switching. When the Defibrillator is not plugged into ac mains, relay K1 is in the normally closed position and the battery is connected to the rest of the Defibrillator. In this state, CR11 prevents the battery from reverse biasing the charging current source. When the Defibrillator first has power applied to it, the power switching circuitry starts-up and the +12V supply rises. Q6 turns on through C10 and pins 11 and 6 of RN1. This keeps Q12 off, allowing the voltage on soft start capacitor C16 to rise. Eventually the gate threshold of Q13 is reached, turning Q13 on. Capacitor C22, which is initially discharged, acts as a short circuit allowing maximum current to energize K1. The energized coil of K1 switches the relay to the normally open position. When C22 is completely charged, the current through coil drops to a level sufficient to hold K1 in its energized state. This connects ac power to the rest of the Defibrillator.

Upon removal of ac power, Q6 turns off and Q12 turns on momentarily. This allows quick discharge of C16 and turns off Q13. With Q13 off, K1 returns to its normally closed position, reconnecting battery power.

1-100. Speaker Driver. A secondary function of the Power Supply PCB is to drive the speaker which produces key click and informative tones. Q7 and Q8 form a push-pull driver stage which is ac coupled through C27 to an eight ohm speaker. P18, pins 1 and 3, are connected to a rear panel potentiometer which sets the tone volume. Normally, when no tone is present, the speaker drive line presents a high impedance. In this case, the base of Q7 is pulled to +12V and C27 is charged to this voltage, less a diode drop. When a tone is to be applied, the speaker drive line is alternately pulled to ground and floated. The volume adjust potentiometer then acts as a divider, applying an ac signal to the bases of Q7 and Q8 whose amplitude is proportional to the potentiometer setting. This signal, through C27, drives the speaker.

In order to provide key clicks of a constant volume independent of the potentiometer setting, a separate driver and input is provided. The key click signal is applied to the base of Q9, causing it to turn on and reverse bias zener diode CR26. The bases of Q7 and Q8 are pulled down a fixed amount, resulting in an independent key click amplitude.

1-101. MAIN PCB ASSEMBLY (802715).

The Main PCB Assembly provides the Defibrillator with the following functions: pulse width modulated isolated power supply; Energy Storage Capacitor (ESC) charging; instrumentation amplifier; transfer and dump relay drive. Additional circuitry has been provided for ON/OFF control, power distribution and optical interface with the LIFEPAK 8 Monitor. QUIK-LOOK ECG is amplified and frequency modulated for transmission across this optical interface. (See Figures 1-19 and 5-29.)

1-102. ON/OFF Control. Power for the Defibrillator is electronically switched under control of either the front panel ON control or the Monitor when PADDLES are selected. The Charger and battery voltage is monitored to ensure the ON/OFF CONTROL is reset when power is applied or voltage is too low.

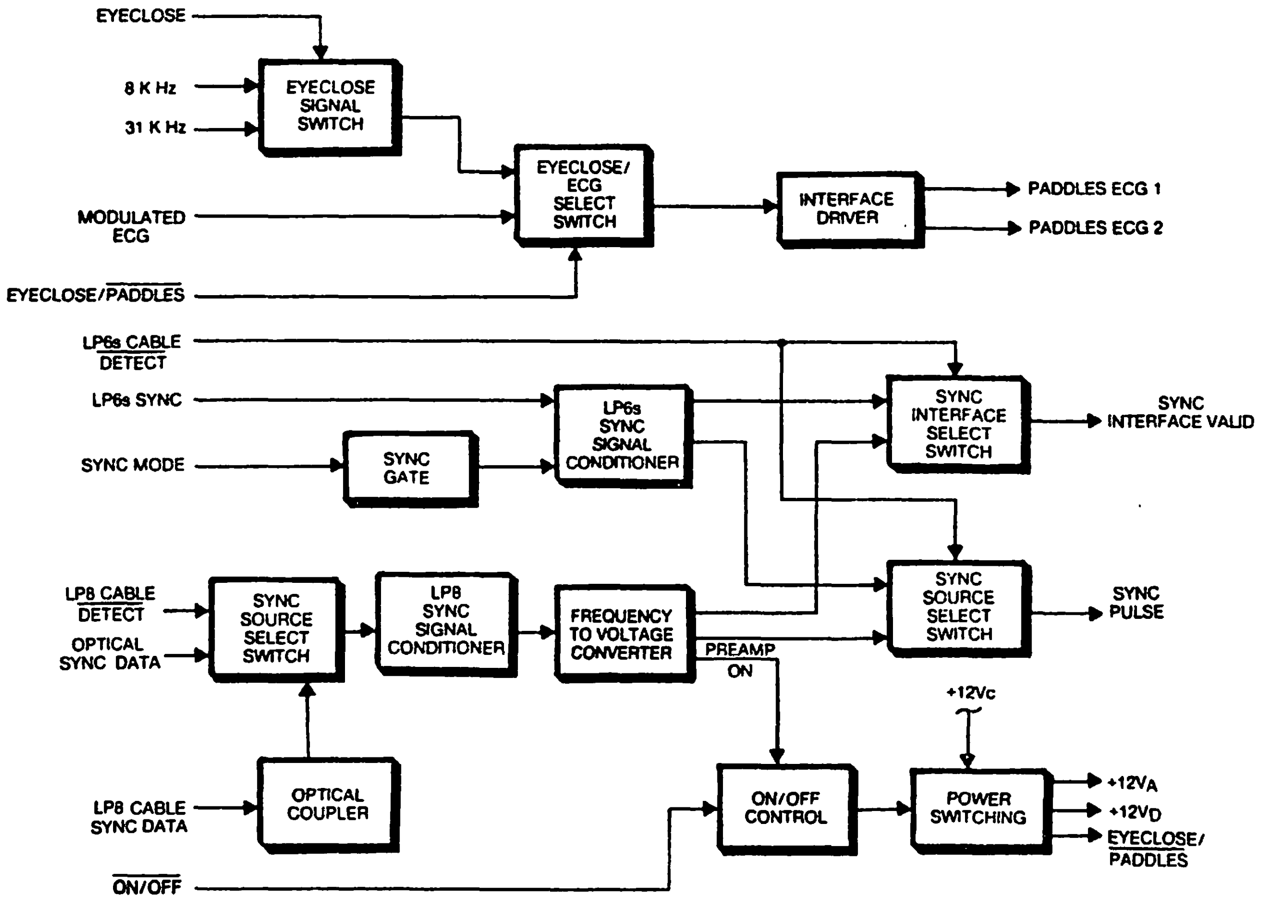
EYECLOSE
8 K Hz
31 K Hz
EYECLOSE SIGNAL SWITCH
EYECLOSE/ ECG SELECT SWITCH
INTERFACE DRIVER
PADDLES ECG 1
PADDLES ECG 2
MODULATED ECG
EYECLOSE/PADDLES
LP6s CABLE DETECT
LP6s SYNC
SYNC MODE
SYNC GATE
LP6s SYNC SIGNAL CONDITIONER
SYNC INTERFACE SELECT SWITCH
SYNC INTERFACE VALID
LP8 CABLE DETECT
OPTICAL SYNC DATA
SYNC SOURCE SELECT SWITCH
LP8 SYNC SIGNAL CONDITIONER
FREQUENCY TO VOLTAGE CONVERTER
SYNC SOURCE SELECT SWITCH
SYNC PULSE
PREAMP ON
+12Vc
LP8 CABLE SYNC DATA
OPTICAL COUPLER
ON/OFF CONTROL
POWER SWITCHING
+12VA
+12VD
EYECLOSE/ PADDLES
ON/OFF

FIGURE 1-19. MAIN PCB ASSEMBLY INTERFACE SECTION BLOCK DIAGRAM

The Power Supply PCB Assembly provides $+12V_C$, fused at 2.5A, to J11, pins 15A and 15B, which is filtered by a network consisting of: C55, C56, C44, C62 and L1. Zener diode CR30 provides over-voltage limiting. Power for the ON/OFF CONTROL, designated $+12V_H$ is derived by CR29, L2, R56 and C45. +12V is controlled by comparator^{H}circuitry centered around U26. This circuit compares $+12V_H$ to a reference voltage set by U25. When $+12V_H$ falls below 7.3V, U26 turns Q23 off. When Q23 is turned off, $+12V_E$ is removed from the power on/off circuit.

The OFF state of U19 is assured by U26 and associated components when ac mains is not connected and when the batteries are too low. The RESET input of U19 is forced high whenever U26, pin 2, is less positive than U26, pin 3.

Actuation of the front panel power switch pulls J10, pins 29A and 29B, to ground, which causes U17C, pin 6, to go high clocking U19, pin 3. However, before reaching U19, some signal conditioning is performed. A low pass filter is formed by R85 and C52. This filter stops excessively short duration pulses from reaching U19. Two inverting Schmidt triggers U17E and U17D, are also included to provide positive input signal transitions.

When U19, pin 3, is clocked, the output $\overline{Q}$, pin 2, is sent to the D input, pin 5. If D is high, $\overline{Q}$ will go low with a positive going clock. In this state, $\overline{Q}$ pulls the gates of Q24 and Q25 low. Q24 and Q25 conduct; supplying $+12V_D$ and $+12V_A$ to the Defibrillator.

The $+12V_D$ supply may be switched on regardless of the state of U19. Steering diodes CR31 through CR34 route the signals from U19 and SYNC INTERFACE VALID for control of the PADDLES output. With Defibrillator power off, PADDLES are selected by a low on $\overline{\text{SYNC INTERFACE VALID}}$. When the Defibrillator power is on, $\overline{\text{SYNC INTERFACE VALID}}$ selects the EYECLOSE channel when low and PADDLES when high.

1-103. Isolated Power Supply. Patient leakage current is limited to less than 10µA by the use of an isolated power supply. Whenever $+12V_D$ is on, the pulse width modulator, U11, chops this voltage at 30kHz as determined by R20 and C18. The output is coupled to the isolated secondary of T1. Isolated dc voltages are derived from the circuit consisting of CR4, C14, C15, U9 and U10. (See Figure 1-20.)

1-104. Paddles Preamplifier. The QUIK-LOOK feature electrically isolates the paddles from earth ground. Patient leakage protection is ensured through the use of an isolated preamplifier. The incoming QUIK-LOOK signal is amplified and frequency modulated for transmission to the Monitor via an optical interface.

The ECG signal from the paddles is applied to a differential amplifier made up of U1A through U1C. The output of this stage is a single-ended signal, at U1C, pin 8, with a gain of 500. Small dc offsets are extracted by U1D which acts as a variable impedance source for the voltage divider formed by R12, R11 and RN13, pins 4 and 5. This circuit effectively controls the size of the signal applied to the noninverting input of U1C. R12 is adjusted to compensate for circuit tolerances and enhance common mode rejection. This circuit constitutes the slow dc restore loop.

Large dc offsets are sensed by a window detector made up of U2C and associated components. Whenever the output of U1C, pin 8, exceeds ±3.0V, U2C, pin 8, goes low and turns off Q1. When Q1 is off, the gain of U1D is increased as is the low frequency response of the differential amp. The result is that large dc offsets are rapidly rejected.

The circuit consisting of U2A and its associated components reduce the effect of ac signals common to both paddle electrode inputs. This is accomplished by summing the complement of such signals into the front end of the differential amplifier.

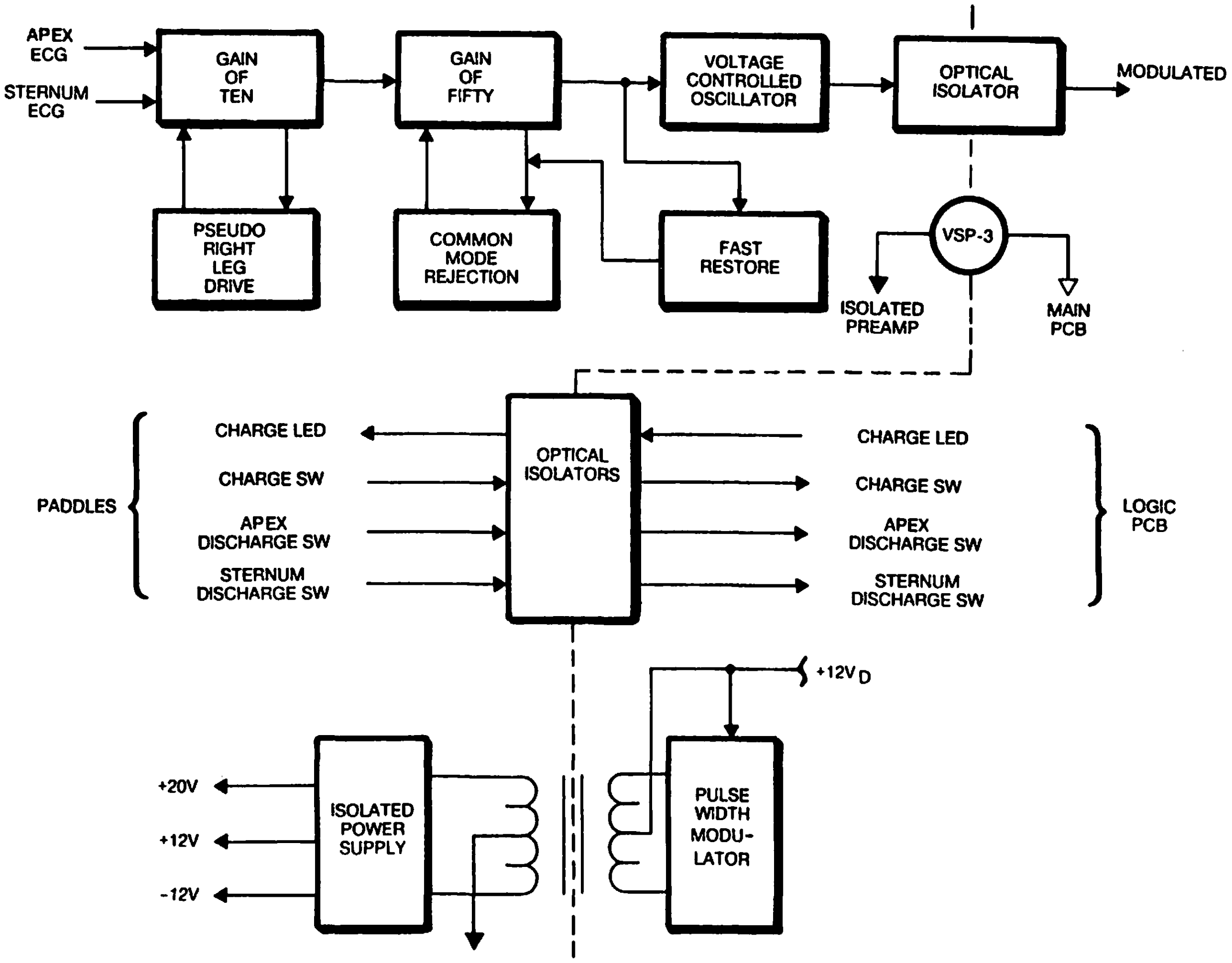
APEX ECG
STERNUM ECG
GAIN OF TEN
GAIN OF FIFTY
VOLTAGE CONTROLLED OSCILLATOR
OPTICAL ISOLATOR
MODULATED
PSEUDO RIGHT LEG DRIVE
COMMON MODE REJECTION
FAST RESTORE
VSP-3
ISOLATED PREAMP
MAIN PCB
PADDLES
CHARGE LED
CHARGE SW
APEX DISCHARGE SW
STERNUM DISCHARGE SW
OPTICAL ISOLATORS
CHARGE LED
CHARGE SW
APEX DISCHARGE SW
STERNUM DISCHARGE SW
LOGIC PCB
+12VD
+20V
+12V
-12V
ISOLATED POWER SUPPLY
PULSE WIDTH MODU-LATOR

FIGURE 1-20. MAIN PCB ASSEMBLY ISOLATED PREAMP SECTION BLOCK DIAGRAM

The single-ended ECG signal is frequency modulated by U3, a phase locked loop (PLL). With a shorted paddle input, the PLL output, U3, pin 4, has a 15kHz square wave, which is set by C13 and R17. The frequency deviates ± 5kHz as the ECG signal input voltage changes at U3, pin 9. FET Q2 provides rapid switching of the PLL output to the opto-coupler, U4. The modulated ECG signal is fed from U4, pin 3, to U12B, pin 6, for further processing by the optical interface.

1-105. Optical Interface and Accessory Cable. The Defibrillator carries on two-way communication with the Monitor via the Optical Interface Assembly or an accessory cable. The accessory cable may also be used to communicate with a LIFEPAK 6s Monitor for synchronized cardioversion. Three separate optical channels are utilized to process Analog Data, Tri-State Control and Serial Data. Refer to Figure 1-2.

1-106. Optical Channel One. ECG/EYECLOSE data is multiplexed onto the interface by U13A. When PADDLES is selected by the Monitor, U13A, pin 11, is high; enabling the output of U12B, which functions as a comparator through U13A, pin 14. During Pacing Cassette operation, U13A, pin 11, is low and the two-state EYECLOSE is available at U13A, pin 14.

Pacing Cassette operation overrides the paddles output via $\overline{\text{SYNC INTERFACE VALID}}$. At this time, an 8kHz EYES OPEN signal is present at U13A, pin 14. Upon receipt of an EYECLOSE pulse, U13B switches a 40ms, 31kHz burst to pin 15.

Optical channel one is driven by Q4, Q5 and associated components. When U13A, pin 14, goes low, Q4 turns on and Q5 turns off. The +12V step at the collector of Q4 is differentiated by C19 and C20; creating a narrow spike which is fed to the LEDs. When U13A, pin 14, goes high, Q4 turns off while Q5 is turned on by R90. The emitter of Q5 is switched to ground providing a rapid discharge of C19 and C20 through CR6 and CR7. These diodes also clamp the waveform to ground.

1-107. Optical Channel Two. Selection of ECG or EYECLOSE/SYNC is handled through the second optical channel. A tri-state, frequency modulated, signal is processed through U13C which is defined as follows:

STATE	DEFIBRILLATOR POWER	CONDITION
INACTIVE (LOW)	OFF	NOTHING
INACTIVE (LOW)	ON	PADDLES
8kHz	OFF	PADDLES
8kHz	ON	SYNC/EYECLOSE
31kHz	ON	SYNC PULSE

NOTE: The 8kHz and 31kHz signals are made up of 1.5μs positive pulses.

Selection of the SYNC DATA source is made by LIFEPAK 8 CABLE $\overline{\text{DETECT}}$. A low at J11, pin 14B, enables the CABLE input; a high enables the OPTICAL input. Selected SYNC DATA is ac coupled through C63 to a pulse squaring circuit made up of U21A and U21B. Inverting amplifier U21A insures there is a signal of adequate strength to be processed by comparator U21B. The output of U21B, pin 7, is a series of 1.5μs, +12V pulses at the input frequency.

The phase locked loop (PLL), U18, provides a dc output at pin 10 which varies directly with the frequency at its input, pin 14. The leading edges of pulses fed to pin 14 are detected by a phase comparator whose output, pin 13, is used to control a voltage controlled oscillator (VCO). If the input is running faster than the VCO, the phase comparator output will be high a greater proportion of time which increases VCO frequency. The phase comparator output, pin 13, is fed to a low pass filter consisting of R67, R76, and C57, which provides a triangle input to the VCO, at pin 9. As the VCO input increases, its frequency output increases until the VCO is locked to the signal input.

An 8 kHz signal from U13C will trigger U24B and force its output low. This low is $\overline{\text{SYNC INTERFACE VALID}}$. The signal is inverted by U17F which turns Q21 off; allowing U23A, pin 13, to float to +5V. Demodulation of a 31kHz signal (SYNC) will force comparator U24A, pin 1, low. This $\overline{\text{SYNC PULSE}}$ is inverted by U17B and fed to switch U23B. The condition of LIFEPAK 6s CABLE DETECT determines which sync circuit has control of the sync interface. A low at U23, pins 10 and 11, enables the LIFEPAK 6s; a high enables the LIFEPAK 8.

The LIFEPAK 6s Monitor may be used to synchronize the LIFEPAK 8 Defibrillator to a patient generated R wave. LIFEPAK 6s SYNC (J11, pin 13B) is a tri-state signal that is used to indicate that the Monitor is connected, the sync is enabled, and the sync pulse is present.

When sync is requested, SYNC MODE goes high and toggles U20D, pin 13, high. Since the output of U20 is open collector, LIFEPAK 6s SYNC is allowed to float as high as +12V. Normally, with a LIFEPAK 6s Monitor connected, this line will be held to less than +2.5V; sync is enabled but no R wave has been detected. Any circuit fault that allows U20B, pin 4, to rise above 8.5V will force U20B, pin 2, low which signifies LIFEPAK 6s sync interface is NOT valid. Detection of an R wave by the LIFEPAK 6s Monitor results in a 6.2ms, +5V pulse at U20C, pin 9. This pulse exceeds the +2.5V reference on pin 8 and forces U20C, pin 14, high. This high level is routed through U23B as a SYNC PULSE to the Logic PCB Assembly.

1-108. Optical Channel Three. The third LIFEPAK 8 optical channel is used solely for Defibrillator serial data which is generated on the Logic PCB Assembly (Refer to paragraph 1-127).

1-109. Energy Storage Capacitor Charger. The Energy Storage Capacitor (ESC) charger operates as a dc-to-dc step-up converter. The circuit is comprised of an oscillator, current switch and a flyback transformer. The converter operates in the high power mode when charging to 20-360J. Low power (slow) charging is used for refresh or when an energy level of 1-10J is required. Overcharge protection circuits disable the ESC charger if the high voltage output reaches 5000V. (Refer to Figure 1-21.)

1-110. Oscillator/Control. The oscillator and control is comprised of U15, Q6 through Q9 and associated components. Timer U15 provides an unbalanced square wave, between 10 and 20kHz, to the current switching network made up of Q11 through Q14.

Energy Storage Capacitor (ESC) charging is initiated when CHARGE goes high and Q6 conducts, however, the $\overline{\text{DUMP}}$ line must go high, opening the dump relay through Q10, before Q7 may conduct. Timer oscillation begins when U15, pin 4, goes high.

The primary timing elements, C22, CR9, R24 and R25, control the total time U15, pin 3, is high during each oscillator cycle. Internal U15 comparators, fixed at one-third and two-thirds of +5.1V (set by zener CR14), sense the voltage on C22; forcing U15, pin 3, high, when C22 is charging and low when its discharging. U15, pin 7, is switched to ground when the voltage at U15, pins 6 and 2, equals two-thirds of +5.1V, providing a path for the discharge of C22 to the one-third reference.

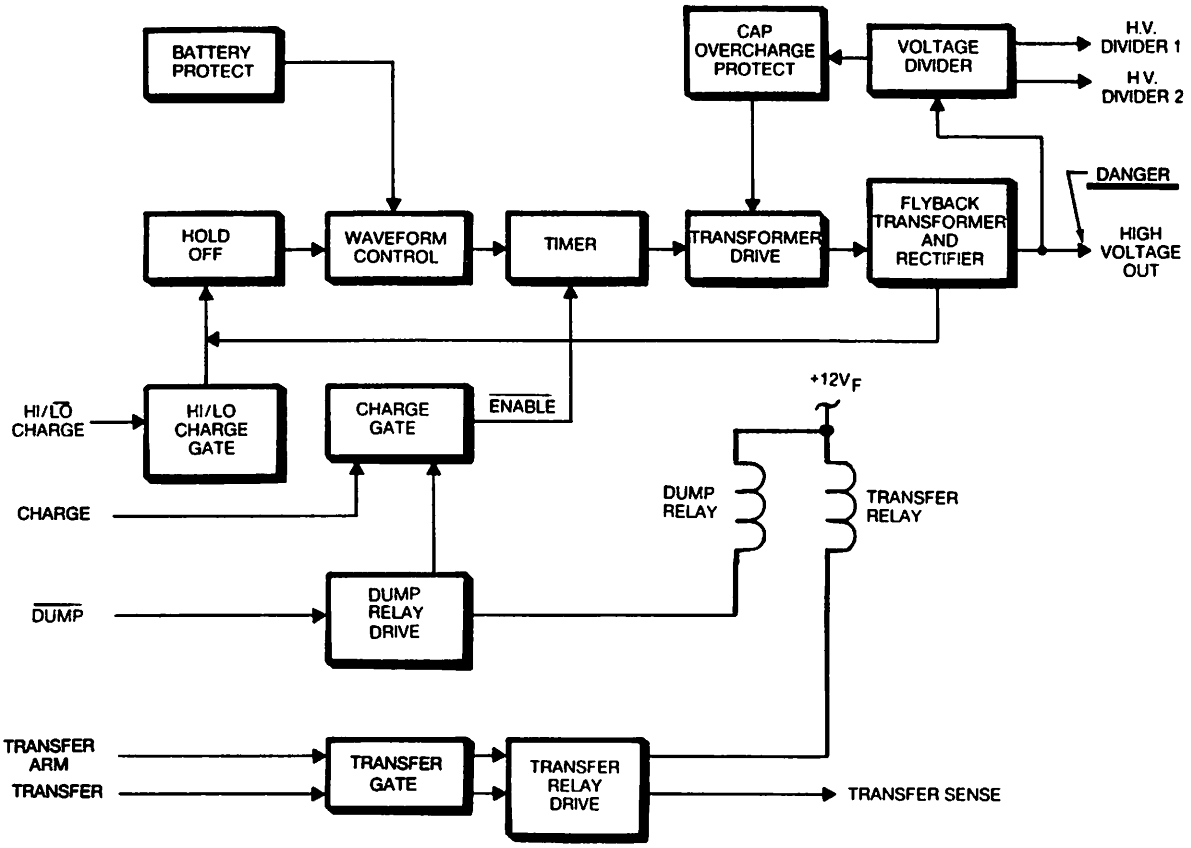
BATTERY PROTECT
CAP OVERCHARGE PROTECT
VOLTAGE DIVIDER
H.V. DIVIDER 1
H.V. DIVIDER 2
DANGER
HOLD OFF
WAVEFORM CONTROL
TIMER
TRANSFORMER DRIVE
FLYBACK TRANSFORMER AND RECTIFIER
HIGH VOLTAGE OUT
HI/LO CHARGE
HI/LO CHARGE GATE
CHARGE GATE
ENABLE
+12VF
DUMP RELAY
TRANSFER RELAY
CHARGE
DUMP
DUMP RELAY DRIVE
TRANSFER ARM
TRANSFER
TRANSFER GATE
TRANSFER RELAY DRIVE
TRANSFER SENSE

FIGURE 1-21. MAIN PCB ASSEMBLY HIGH ENERGY CONTROL SECTION BLOCK DIAGRAM

Discharge of C22 is controlled by RN10, pins 3 and 4, Q8 and R26. As long as current is flowing in the secondary of T2, the base of Q8 is held off by -0.6V. When secondary current ceases, the CR9 zener voltage is reestablished, allowing Q8 to conduct and discharge C22. This hold-off period is necessary for efficient transfer of energy and may be adjusted by R26.

The low power charge mode is enabled when HI/LO CHARGE is low. In this state, Q9 conducts and places C21 in the flyback circuit. The hold-off period is increased because C21 slows the re-establishment of the +3.3V zener potential of CR9. Rapid discharge of C21 is permitted by CR11.

Low battery compensation is provided by U14A. Should battery voltage drop to +9V, U14A, pin 1, will go high and supply additional charge current to C22. Rapid charging of C22 reduces the pulse width output from U15, pin 3, which in turn, shortens the current switch on time.

1-111. Current Switch. Large currents must be switched through the primary of T2 during Defibrillator charge. Q14 conducts when Q13 is turned on by a high from U15, pin 3; Q11 and Q12 are off and C24 is charging through CR16. Primary current flows during this period and energy is stored in the core of T2. After 60µs, U15, pin 3, goes low. Q14 and Q13 are now off; Q11 and Q12 turn on. Conduction of Q12 grounds the positive side of C24 and couples a negative turn-off spike to the base of Q14. The rapid turn-off of Q14 increases charger efficiency.

As the primary field collapses, a high voltage current pulse is induced into the secondary of T2. This positive pulse is applied to the Energy Storage Capacitor through the forward biased CR18.

Diode CR17 clamps the base of Q14 to -0.6V. C23 speeds up turn on of Q12. CR20 protects Q14 by shunting inductive voltage spikes that would exceed its maximum collector to emitter voltage.

1-112. Overcharge Protection. The Defibrillator Energy Storage Capacitor (ECS) is prevented from charging above +5000V in the event of a failure of the Logic PCB Assembly. HI VOLTAGE DIVIDER #2 is monitored and compared against a +2.5V reference by U14B. If the inverting input of U14B exceeds the noninverting input, U14B, pin 7, will go low, turning on Q11 and inhibiting ESC charger operation. Energy Storage Capacitor voltage must be reduced to less than 1000Vdc before the overcharge protection circuit releases its hold on the charger. $\overline{\text{RESET INHIBIT}}$ prevents U14B from latching, at power-on, through the conduction of Q26 and Q15.

1-113. ESC High Voltage. Voltage dividers provide a low voltage analog representation of the Energy Storage Capacitor (ECS) voltage. CR28 clamps the divider lines to $+12V_A$ in case the divider grounds open. R40 and C26 ensure the charger will not charge into an open circuit should the output, at P21, open. High frequency noise from charger operation is shunted by C28 and C31.

1-114. Transfer/Dump Relay Drive. The transfer and dump relays are activated by control signals from the Logic PCB Assembly. The dump relay must open prior to activation of the ESC charger. Once charging is complete, a two step transfer command must be received before energy is delivered to the paddles.

NOTE: The dump condition is a normal state for the Defibrillator. Energizing the dump relay or its drive circuitry implies that relay contacts are being opened. The term dump refers to the transfer of stored energy in the Storage Capacitor.

The dump relay is energized when $\overline{\text{DUMP}}$ goes high and turns on Q10, providing a current path from ground through the relay to $+12V_E$. The transfer relay is armed when the discharge switches are closed by a low on TRANSFER ARM. The Logic PCB Assembly delivers a 200ms, positive pulse to the base of Q18 when all conditions for transfer have been met.

Two transistors, Q17 and Q20, must be conducting simultaneously for the transfer relay to energize. Safety is insured, in that no single shorted transistor will cause the Defibrillator to transfer. TRANSFER SENSE goes high when the discharge switches are closed and low when TRANSFER goes high. TRANSFER SENSE is routed to the Logic PCB for use in SYNC TEST.

1-115. LOGIC PCB ASSEMBLY (802725).

The Logic PCB Assembly controls and monitors many of the LIFEPAK 8 Defibrillator functions. These functions can be separated into two categories: user input processing and mode control, and system status monitoring and generation of user status indications. (See Figures 1-22 and 5-30.)

These tasks are accomplished through the use of two interconnected microprocessors. The Controller microprocessor, U18, accepts all user inputs and controls Defibrillator charge, discharge and energy dump. The Controller microprocessor also drives the low energy digit, charge and sync indicators. The Monitor microprocessor, U1, controls the available energy display, test load energy display and their associated legends. In addition, U1 controls the alarm, service and low battery legends, and formulates Defibrillator status information for serial output to the LIFEPAK 8 Monitor.

The microprocessors execute self-test routines continuously so any fault that presents a hazard will result in the disabling of Defibrillator controls. Other faults, of a less critical nature, may result in partially disabled functions. For example, a transfer timing malfunction will inhibit sync discharge. Either a fault or hazard condition will result in a service alert to the user. Most malfunctions result only in a service alert.

1-116. Reset Circuits. During power-on of the Defibrillator, the microprocessors are reset to starting program address 0000H. This reset state is held for 100ms to allow the Logic PCB Assembly power supplies and clocks to stabilize. System integrity is then monitored continuously and, a system fault reset is generated if a malfunction is detected. Watchdog circuits are disabled until the reset cycle is complete and microprocessor operation begins.

The +5V power supply is compared to +2.5VREF4 by U15A through U15C. An RC network formed by R9, R10, C26, and C27 conditions the POWER OK signal so that a decrease in the +5V supply will rapidly trigger a RESET cycle. As C26 and C27 charge, POWER OK reaches +2.5V; forcing the open collector outputs of U15A through U15C high. C19 will begin to charge, through R28, toward +5V. The output of U12F, pin 12, is driven high, providing a 2.25s RESET INHIBIT, until C19 charges sufficiently to be considered a logic 1. This inhibit is applied to NOR gates U11B and U11D causing their outputs to be low which are inverted by U14A and U14G respectively. The RC time of RN4, pins 6 and 11, and RN7, pins 4 and 13, determines the 100ms duration of power up RESET signals applied to the microprocessors.

For the -08 assembly, U15B is configured with R63, R64, C53, and Vref 4 to form the reset circuit for both microprocessors in the event of a surge in the +5V supply. This circuit, together with U15A and U15C, function as a window comparator for the +5V power supply microprocessor reset circuit.

If the microprocessor does not trigger its watchdog by the time RESET INHIBIT goes low, the microprocessor will be reset. In this case, the user must bring the microprocessor out of reset by pressing the CHARGE switch. This action grounds U15A, pin 1, discharges C19 and generates another $\overline{\text{RESET INHIBIT}}$.

1-117. Watchdog and Power Monitoring. The watchdog circuits are used to determine if the microprocessors are operating within Defibrillator design limits. If for some reason either microprocessor fails to function, their respective watchdog will issue a $\overline{\text{RESET}}$ command.

NOTE: The watchdog for U18 is discussed in paragraph 1-125, Controller Inhibit.

The U1 watchdog operates in the same fashion as the U18 watchdog. U7A, pin 4, is retriggered, keeping Q, pin 6, high, by the chip select originating at U1, pin 27. Interruption of this signal will cause Q to go low and $\overline{Q}$, pin 7, to go high. The Q output of U7A is fed to a NOR gate U11B whose output will be a high if the $\overline{\text{RESET INHIBIT}}$ is low. This high is again inverted by U14A, discharging C11, and becomes $\overline{\text{RESET}}$ for U18.

1-118. Voltage Reference Regulators. The Logic PCB Assembly requires voltages other than the +12V supplied by the battery or the Power Supply PCB Assembly. To develop these voltages, +12VA is applied to three-terminal regulators, U16, U17, and U26, and zener diode CR3 producing +5V for logic, +5VREF1 , +2.5VREF2, and +2.5VREF4. A fourth reference, VREF3, is used to clamp analog signals to +5Vdc. This reference is taken from the emitter of Q3 and is set at +4.3V by the voltage drop across CR4 and CR5.

1-119. Unregulated -10Vdc Power Supply. Unregulated -10Vdc is used to ensure Q5 through Q11, of the energy select circuit, are turned off when they are supposed to be. Since -10Vdc is not generated elsewhere, a charge pump is used.

The 977Hz output from the clock divider, U22, is fed to U13F, pin 6, where +5V logic is converted to +12V signal level. A high at U13, pin 13, charges C15 to +12V through CR20. When pin 13 goes low, C15 will have -12V stored with respect to ground. This -12V forward biases the half wave rectifier, CR19, and C15 distributes its charge to C16. The voltage at C16 is the unregulated -10Vdc.

1-120. Clock Divider. Division of the 1MHz E clock is used to derive 500kHz, 31kHz, 8kHz, 1953Hz, 977Hz and 488Hz square waves for use in other Defibrillator circuits. This frequency division takes place in U22, a twelve stage binary ripple counter.

1-121. Switch and Interlock Sensing. The Controller microprocessor, U18, senses the status of the switch and interlock inputs at a 1200Hz rate. Any switch closures result in a mode change and the output of KEY CLICK. Switch and interlock inputs to the Controller microprocessor, U18, are converted from parallel to serial format by U20 and U21. These parallel in and serial out shift registers load switch status when pin 1 of U20 and U21 goes low. Latch is again set high by U18, pin 15, and the Controller microprocessor outputs a serial shift clock that moves data, starting with the most significant bit, through U21, pin 9, into U18, pin 9.

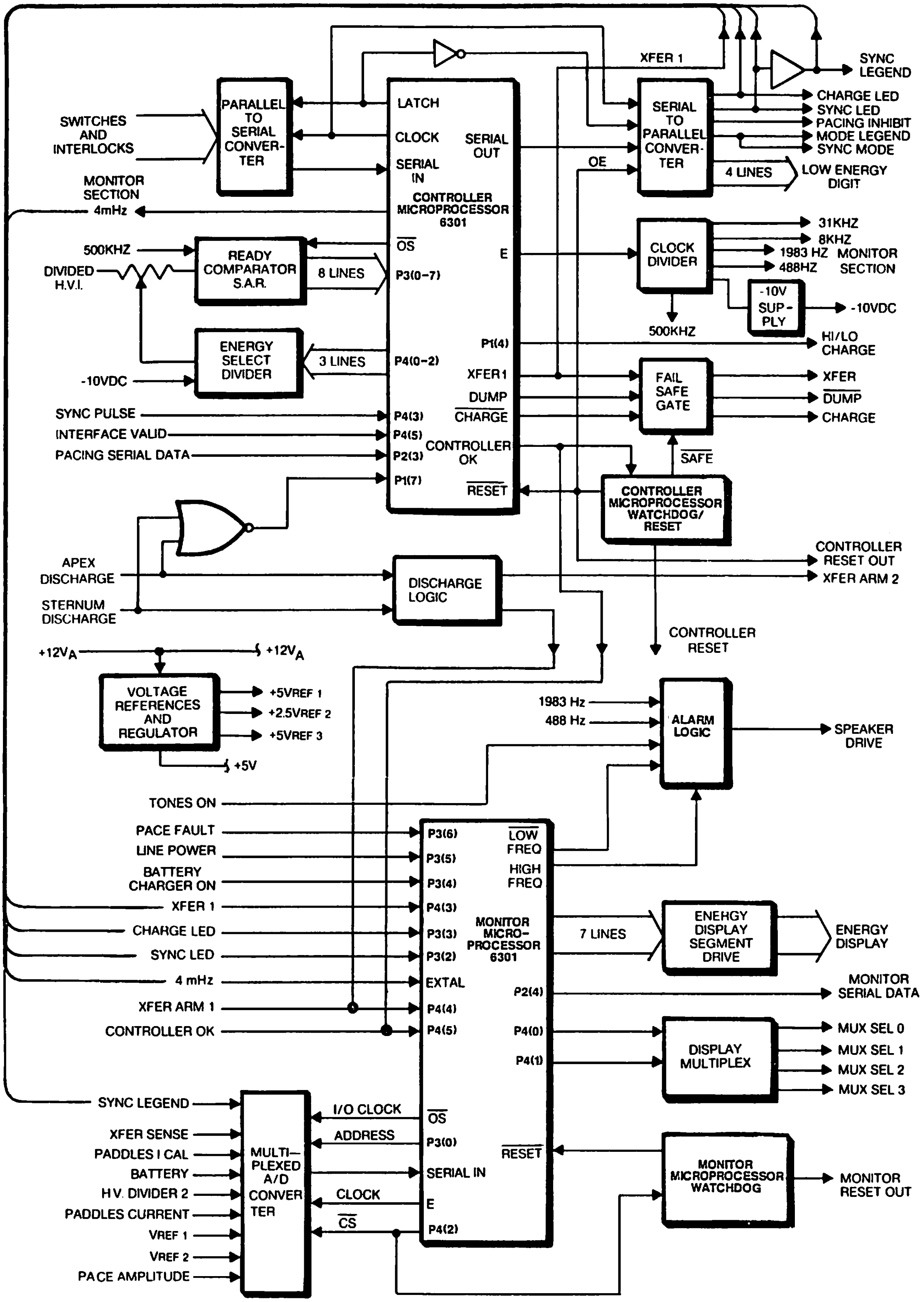
SWITCHES AND INTERLOCKS
PARALLEL TO SERIAL CONVERTER
MONITOR SECTION
4mHz
LATCH
CLOCK
SERIAL IN
SERIAL OUT
CONTROLLER MICROPROCESSOR 6301
XFER 1
SYNC LEGEND
SERIAL TO PARALLEL CONVERTER
OE
CHARGE LED
SYNC LED
PACING INHIBIT
MODE LEGEND
SYNC MODE
4 LINES
LOW ENERGY DIGIT
500KHZ
DIVIDED H.V.I.
READY COMPARATOR S.A.R.
8 LINES
OS
P3(0-7)
E
CLOCK DIVIDER
31KHZ
8KHZ
1983 HZ
488HZ
MONITOR SECTION
-10V SUPPLY
-10VDC
500KHZ
ENERGY SELECT DIVIDER
3 LINES
P4(0-2)
-10VDC
P1(4)
HI/LO CHARGE
XFER 1
DUMP
CHARGE
FAIL SAFE GATE
XFER
DUMP
CHARGE
SYNC PULSE
INTERFACE VALID
PACING SERIAL DATA
P4(3)
P4(5)
P2(3)
P1(7)
CONTROLLER OK
RESET
SAFE
CONTROLLER MICROPROCESSOR WATCHDOG/ RESET
CONTROLLER RESET OUT
XFER ARM 2
APEX DISCHARGE
STERNUM DISCHARGE
DISCHARGE LOGIC
CONTROLLER RESET
+12VA
+12VA
VOLTAGE REFERENCES AND REGULATOR
+5VREF 1
+2.5VREF 2
+5VREF 3
+5V
1983 Hz
488 Hz
ALARM LOGIC
SPEAKER DRIVE
TONES ON
PACE FAULT
LINE POWER
BATTERY CHARGER ON
XFER 1
CHARGE LED
SYNC LED
4 mHz
XFER ARM 1
CONTROLLER OK
P3(6)
P3(5)
P3(4)
P4(3)
P3(3)
P3(2)
EXTAL
P4(4)
P4(5)
LOW FREQ
HIGH FREQ
MONITOR MICRO-PROCESSOR 6301
7 LINES
ENERGY DISPLAY SEGMENT DRIVE
ENERGY DISPLAY
P2(4)
MONITOR SERIAL DATA
P4(0)
P4(1)
DISPLAY MULTIPLEX
MUX SEL 0
MUX SEL 1
MUX SEL 2
MUX SEL 3
SYNC LEGEND
XFER SENSE
PADDLES I CAL
BATTERY
H.V. DIVIDER 2
PADDLES CURRENT
VREF 1
VREF 2
PACE AMPLITUDE
MULTI-PLEXED A/D CONVERTER
I/O CLOCK
ADDRESS
CLOCK
CS
OS
P3(0)
SERIAL IN
E
P4(2)
RESET
MONITOR MICROPROCESSOR WATCHDOG
MONITOR RESET OUT

FIGURE 1-22. LOGIC PCB ASSEMBLY BLOCK DIAGRAM

NOTE: The data in U20 must shift into U21 before entering U18.

1-122. Key Click and Alarm Logic. Alarms are used to draw attention to the status of the Defibrillator. A low frequency tone indicates Defibrillator charge is complete and ready to discharge. A high frequency tone indicates failures or low battery. Key clicks provide the user with audible feedback to show that a key command has been recognized. A KEY CLICK command may originate in the Pacing Cassette or the Controller microprocessor.

488Hz and 1953Hz, from the clock divider, are routed to U25A and U25B. A $\overline{\text{LOW FREQUENCY}}$ command from U1, pin 23, enables 488Hz through U25A. This signal is inverted in U25C and U25D where it is applied to U14C for output to the speaker. A 1953HZ signal is gated to the speaker whenever U8B, pin 11, goes low. U8 is a dual one of four decoder; a two bit input code drives one of four outputs high. With tone disabled, U1, pin 20, is high which forces U8B, pin 11, high. A high input at U8B, pin 13, from TONE ON or a low at U8B, pin 14, will enable 1953Hz through U25B. Signal flow is now the same as that for 488Hz.

KEY CLICK is a short +5V pulse that is fed to the speaker whenever a switch closure is detected on the Defibrillator or Pacing Cassette. CR16 and CR22 form a logical OR gate to steer the KEY CLICK command.

1-123. Energy Select and Charge Limit. The Controller microprocessor, U18, reads the energy selector through the parallel to serial shift register, U21. The energy select switch provides the following four bit code:

	P1 Pin 9	P1 Pin 10	P1 Pin 12	P1 Pin 11
Low	H	H	H	H
10J	L	H	H	H
20J	H	L	H	H
30J	L	L	H	H
50J	H	H	L	H
100J	L	H	L	H
150J	H	L	L	H
200J	L	L	L	H
300J	H	H	H	L
360J	L	H	H	L

If LOW is selected, energies between one and nine joules may be selected by the use of the low energy increase and decrease switches.

The energy select word, described above, is used within U18 as one input to a digital energy comparator. The second input to this energy comparator is developed by successive approximation register (SAR) U19 that converts divided capacitor high voltage to a digital word. The Controller microprocessor samples the SAR at a 1200Hz rate. A comparison of these two words are used to continue charging, dump energy, initiate refresh or terminate charge and illuminate the AVAILABLE legend.

The signal input to U19 must be scaled to a range in proportion to the energy level selected. A voltage divider is formed between the Energy Storage Capacitor and ground. A tap on this divider is applied to pin 5 of U10B, an amplifier with gain adjustable by varying R19, to correct circuit tolerances. The division factor is determined by grounding resistors in RN5. A three bit word, from U18, pins 27 through 29, is input to multiplexer U24 which selects one of seven outputs, connected to Q5 through Q11. The output is switched from -10V which turns the FET off to 0V which causes the FET to conduct, resulting in a resistor in RN5 being selected. The following table shows which resistors are grounded for a particular energy setting.

Energy Selected	RN5 Pins Grounded
1 Joules	9
2-3 Joules	9, 3
4-6 Joules	9, 4
7-10 Joules	9, 5
20-30 Joules	9, 6
50 Joules	9, 7
100-150 Joules	9, 8
200-360 Joules	9, 2

1-124. Dump and Charge Control. Before Defibrillator energy can be stored, the dump relay must be opened, the charge oscillator must be enabled and either the HI or LOW charge rate must be selected.

The Controller microprocessor will make a determination, based on software, of the charge status. Upon receipt of a CHARGE command, U18, pins 10 and 16 go low activating $\overline{\text{DUMP}}$ and CHARGE respectively. The HI charge rate is used for selected energies from 20 joules through 360 joules. LOW charge is used for 1 joule through 10 joules or refresh.

1-125. Status Indicators and Energy Display. Front panel indicators are driven by several circuits on the Logic PCB Assembly. The available energy display segment code is provided by Monitor microprocessor U1, pins 13 through 19. This display word is applied to high current Darlington transistor array U5, that provides energy display segment drive.

Low energy digit, charge, and sync mode indicators are developed from the output of U23, a serial to parallel shift register. Data is shifted into U23 when its strobe input is high. U18 then outputs serial shift clock pulses from pin 14 and provides the data at U23, pin 13. The parallel outputs of U23 are enabled as long as the CONTROLLER OK output at U18, pin 19, is active.

The seven segment displays, status, and some legend LEDs are multiplexed. U8A is a one of four decoder. The input from U1 at U8A, pins 2 and 3, determines which outputs, Q0 through Q3, will be active. U13 is a high current source driver for the LEDs. The decoder select lines are updated once every 6.8ms (approximately 166Hz) with each one active 25% of the time.

BATTERY and CHARGE legends are active independent of the microprocessors. The SERVICE legend is activated by U1 or the Monitor microprocessor watchdog, U7A.

1-126. Analog to Digital Conversion Multiplexer. To provide the greatest flexibility and ensure maximum utilization of Monitor microprocessor resources, nine analog inputs are sampled by a multiplexed analog to digital converter. This device, U2, has as its inputs: TRANSFER SENSE, PADDLES I CAL, BATTERY, H.V. DIVIDER #2, VREF1, VREF2, PACE AMPLITUDE, SYNC LEGEND and PADDLES CURRENT.

Actual A/D conversion is accomplished by sample and hold and successive approximation. The Monitor microprocessor program calls for a specific analog signal conversion through the output of U2, pin 15, and a four bit serial address to U2, pin 17. At the same time, U1 supplies eight serial clock pulses to the I/O clock input of U2. Eight clock pulses are used so that an address may be loaded at the same time as an eight bit serial data word is output to U1, pin 30. Upon completion of this data/address shift cycle, U2, pin 15, goes high and the conversion cycle begins. The conversion takes place during the forty E clock periods following the eighth I/O clock pulse.

A protocol for sampling is implemented in software. If 100 joules or 360 joules charge is commanded, the Monitor microprocessor will determine if the paddles are stored and the Pacing Cassette is not installed. Having met the above conditions, the Monitor microprocessor will activate U2, pin 6, for 100 joules or U2, pin 5, for 360 joules paddles current sensing. U10A, pin 1, provides a divide by one analog representation of paddles current for use by U2 during 100 joules test load reading. A resistor network, RN5, pins 10-12, divides the current by two for use in the 360 joules test load reading.

PADDLES I CAL is used to provide compensation for circuit tolerances R1 provides a ± 25% adjustment range to the test load calibration. PADDLES I CAL and PADDLES CURRENT samples are then factored into the calculation of test load energy delivered.

HIGH VOLTAGE DIVIDER #2 is used by the Monitor microprocessor to determine how much energy is stored in the Energy Storage Capacitor. The voltage sample from U9A, pin 1, is used to generate the energy available display on the front panel. R3 is for calibration of this display.

TRANSFER SENSE is tested continuously and is used to look for open or shorted transfer drive transistors, Q17 and Q20, on the Main PCB Assembly.

SYNC LEGEND is sampled by U2 to determine that it is active when in sync and inactive when in the Defibrillator mode. A fault detected results in a SERVICE alert.

Voltage references are used extensively in the analog to digital converters. For this reason, VREF1 and VREF2 are sampled by U2. These samples are used by the Monitor microprocessor to calculate the ratio between the voltage references. Any error in this ratio results in a SERVICE alert.

BATTERY is sampled by U2 so that the Monitor microprocessor can give a LOW BATTERY alert. This alert occurs when the battery reaches 10V or when twenty-five 360J discharges have occurred while running on batteries.

1-127. Controller Inhibit. Since the Controller microprocessor controls potentially hazardous voltages, circuitry that monitors and disables its operation is provided.

In normal operation, a 300Hz CONTROLLER OK signal is sent to the Monitor microprocessor and U7B, pin 12. U7B is a retriggerable monostable multivibrator with a pulse width of 4.02ms. As long as U7B, pin 12, is clocked at 300Hz, pin 10 will be high and pin 11 will be low. Any interruption of CONTROLLER OK or a low on CONTROLLER RESET at U7B, pin 11, will cause U7B outputs to switch states. This condition results in a Controller microprocessor reset and disabling of the CHARGE, DUMP, and TRANSFER lines by grounding them through Q12.

1-128. Transfer Relay Control. For safety reasons, the transfer relay is only energized after the following conditions have been met: the Defibrillator has energy stored within the correct tolerance; refresh is not active in SYNC mode; APEX and STERNUM paddle discharge switches have been activated for a minimum of 125ms; the Controller microprocessor has recognized a discharge command; and SYNC pulse is present if in the SYNC mode.

The APEX and STERNUM discharge switches are normally open. When discharge is required, the switches are closed, applying ground on P10, pins 22A, 22B, 21A and 21B. NOR gate U11C, pin 10, goes high, with both switches closed, signaling the Controller microprocessor that transfer is required. Q19 and Q13 are biased on, with lows on their bases. +5V is placed on the noninverting input of comparator U9A which forces its output high. This signal splits into two: TRANSFER ARM is sent to Monitor microprocessor U1, pin 25, and TRANSFER ARM OUT is inverted by U14F and sent to the Main PCB Assembly. The RC time of R27 and C21 determines the minimum time TRANSFER ARM will be active.

For the -08 assembly, the transfer signal at the collector of Q13 is also fed to U2, pin 11 through R61 and R62. This provides redundancy for the transfer signal, which is monitored by the monitor microprocessor U1.

The TRANSFER output P10, pins 19A and 19B, goes low for 200ms. Failsafe operation is ensured because the collector of Q15 can only go high if Q12 is off. The negative going 200ms pulse, is fed to U1, pin 26, for use in the sync test software, display mode software, transfer drive test, low battery detection, and test load operation.

1-129. Serial Data Transmission. The Defibrillator sends serial data to the Monitor via the Optical Interface Assembly. A serial data string is fed from Monitor microprocessor U1, pin 12, to inverter U12B. This inverted +5V logic is converted to +12V logic by U13A and fed to the Optical Interface Assembly.

1-130. PACING CASSETTE

The LIFEPAK 8 Pacing Cassette (see Figure 1-23) is a microprocessor controlled transcutaneous pacemaker. It operates in conjunction with the LIFEPAK 8 Monitor and Defibrillator to provide demand and nondemand pacing pulses for short-term support of patients with circulatory problems. All electronics, displays and controls required for pacing logic and pacing pulse generation are contained within this cassette. However, it is supported by power supplies and electrical interfaces provided by the Defibrillator and indirectly by the Monitor.

1-131. PACING CASSETTE PFC ASSEMBLY (802911).

The Pacing Cassette PFC Assembly (see Figure 5-40) developes and produces the outputs required for cardiac pacing.

1-132. Microprocessor. The Pacer microprocessor, U9, controls all functions performed by the Pacing Cassette. Programming for the microprocessor is stored in an integral 4k by 8 bit ROM. The operating mode of U9, single chip mode, is selected by the state of P2(0-2) at reset. In the single chip mode, all ports may be configured as inputs and outputs. The Pacer microprocessor assigns the inputs and outputs as follows:

Port 1(0-4)	Port 2(0,2-4)	Port 3(0-3)	Port 3(4,5)	Port 4(0-7)
Output Only	Output Only	Input Only	Output Only	Input Only

When +12Vdc is present at J2, pin B1, U10 provides a regulated +5Vdc to the Pacing Cassette circuitry. The Pacer microprocessor is now powered. However, $\overline{\text{RESET}}$ remains low for an additional 20ms because of the RC time of RN7B and C41. This allows the power supply and oscillator to stabilize. When $\overline{\text{RESET}}$ goes high, U9 starts its program and selects single chip operation.

1-133. Control and Display Circuit. The Pacing Cassette is active whenever Defibrillator power is on. Status of the DEMAND, NONDEMAND, START STOP and RATE switches is determined every 10ms by U9, port 4. Upon detection of a switch closure, the microprocessor will output KEY CLICK, illuminate or extinguish the appropriate display, and enter the selected mode of operation.

Port 1 of U9 is connected to a Darlington transistor array, U8. Each of the transistors in U8 has its collector tied, through current limiting resistors, to the cathode of an LED on the Switch Display PCB Assembly. The anodes of the LEDs are tied to +12V. A high from any bit on port 1 will turn on its respective transistor and provide a current path through the LED.

1-134. Pulse Width Modulator. Isolated power supplies and pacing pulses are developed from outputs of the pulse width modulator, U11. The frequency at which U11 operates is determined by R22, R66 and C18. Operation is centered at 30kHz with a ±5kHz adjustment range. Pacing pulse output is adjusted by R66.

A redundant soft start scheme is used to protect Q3 through Q6 from potentially damaging current surges. Output switching from U11 is inhibited until C16 is charged by an internal current source. When oscillation begins, the oscillator output, U11, pins 11 and 14, is fed to the gates of Q3 through Q6 and U13.

1-135. Isolated Power Supply. Pacing Cassette power comes from the Defibrillator +12Vdc circuit. Patient protection from hazardous leakage current is established in the isolated power supply circuitry on the Pacing Cassette PFC Assembly. A 30kHz square wave drives the chopper circuit made up of Q3, Q4, and T2.

The gate drive from U13, pins 4 and 12, is 180° out of phase; while one FET is on, the other is off. When Q3 conducts, current flows in one half of T2's primary, storing energy in the transformer core. This energy is transferred to the secondary when Q3 turns off and the stored energy field collapses. AC voltage from the secondary is rectified by CR2 and filtered to provide isolated ± 12Vdc. A +5V supply is developed from +12V by regulator U4.

1-136. Pulse Generator. The pulse generator, U11, develops positive 20ms trapezoidal pulses for application to the center tap of T1. The pulses are varied in amplitude by adjusting the PACE AMPLITUDE potentiometer, R68. The +5V supply connected to R68 is a precision reference output from U11, pin 9.

When the microprocessor determines that a pulse is necessary, U9, pin 10, will be set low for a period of 50ms. After 20ms, U9, pin 8, goes low which removes ground from R100 and C31. The voltage at R68 is gated to a pulse shaper made up of C30 and R63.

The pulse shaper converts the gated voltage input to a trapezoidal pulse with a 20% slope from the leading to trailing edge. R63 and C30 are selected to provide a linear slope to the 20ms pulse. Diode CR24 clamps the positive input of U12A to ground, preventing this pin from going negative.

Shaped pacing pulses are then fed to an amplifier loop, made up of U12A, Q8 and Q7, which provides a voltage gain of 1.8 as set by R59 and R60. This results in a current gain between U12A and the collector of Q7 which provides a 0-9V, 9A maximum trapezoidal pulse to the center tap of T1.

1-137. Pacing Pulse Output. The gates of pulse chopper FETs Q5 and Q6 are driven continuously but switching occurs only when voltage is present on the center tap of T1. A trapezoidal pulse is gated to T1 when a pacing pulse is necessary. Q5 and Q6 are protected from overvoltage by zener diodes CR18 and CR19. When pulsed, a voltage is induced in the secondary of T1 which is rectified by CR1 and filtered by C1 and CR3 for PACE output.

1-138. Leads Off Detector.

The Pacing Cassette leads off detector senses external impedance to determine continuity of the Pacing Cassette output circuit. In a sense,

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SECTION 2
OPERATION

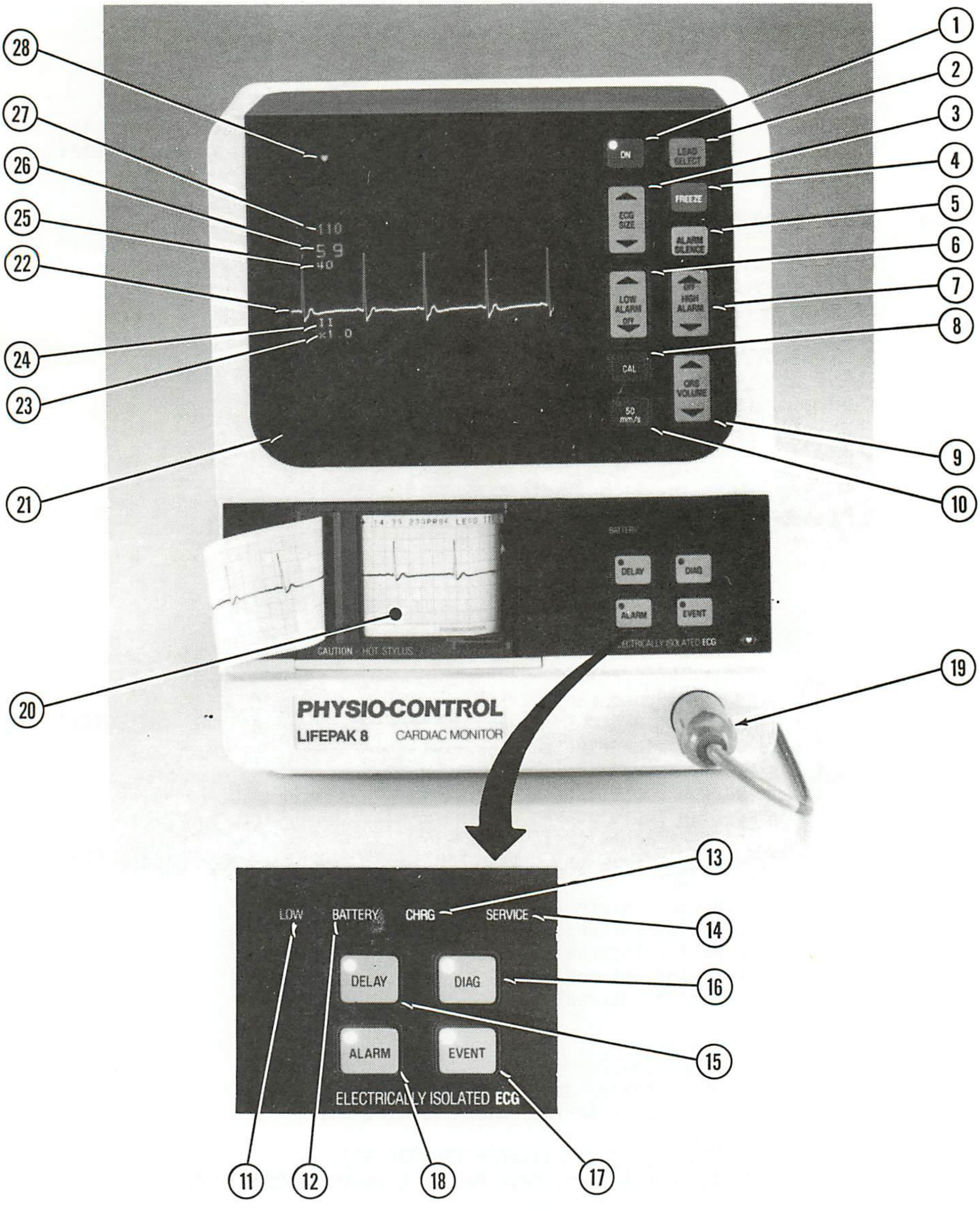
2-1. OVERVIEW

This section of the manual contains information and procedures for the operation and periodic testing of the LIFEPAK 8. A list of accessories and replacement items is also provided.

2-2. ACCESSORIES AND REPLACEMENT ITEMS

The following list is provided for reference only. Customers should contact the factory Order Desk or a District Office when placing an order.

- AC Power Strap (803335-00)
- Adult External Paddles, replacement
- Defibrillator Cassette (802903-00)
- Defibrillation Electrode Cable (803461-01)
- DERMA JEL Electrode Jelly
    - 4 oz. tube (9-10236-00)
    - Case, twelve tubes (9-10236-012)
- Disposable FAST-PATCH Defibrillation Electrodes
    - Carton: 5 sets of 2 pads (803630-105)
    - Case: 5 cartons (803630-125)
- Disposable QUIK-PACE Pacing Electrodes
    - Shelf pack: 5 set of 2 electrodes (803377-501)
    - Case pack: 5 shelf packs (803377-251)
- ECG Paper
    - Box, 3 rolls/box (801262-003)
    - Case, 50 boxes/case (801262-150)
- Electrode Accessory Kit, 12 lead (800153-00) contains the following:
    - 4 metal adult limb electrodes (9-10179-00)
    - 4 adult limb straps (9-10181-00)
    - 30 mm suction cup electrode (9-10183-00)
    - 15 mm suction cup electrode (9-10179-00)
    - 5 lead patient cable (9-10417-00)
- Internal Paddle Handles and Connector (800441-02) specify paddle size from the following:
    - 2.5 cm diameter Internal Paddles, pair (802154-10)
    - 3.8 cm diameter Internal Paddles, pair (802154-11)
    - 5.1 cm diameter Internal Paddles, pair (802154-12)
    - 6.4 cm diameter Internal Paddles, pair (802154-13)
    - 8.9 cm diameter Internal Paddles, pair (802154-14)
- LIFEPAK 6s Sync Kit
- LIFE PATCH ECG Electrodes, adult, pre-gelled
    - Box of 75 (800139-075)
    - Case of 300, 4 boxes/case (800139-300)
- Monitor/Defibrillator Interface Cable (803371-00)
- Operating Instructions
    - LIFEPAK 8 Monitor/Defibrillator (803334-02)
    - QUIK-PACE External Transchest Pacing Cassette (803369-02)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14
16
15
11
12
18
17
110
59
40
II
x1.0
ON
LEAD SELECT
ECG SIZE
FREEZE
ALARM SILENCE
LOW ALARM OFF
OFF HIGH ALARM
CAL
QRS VOLUME
50 mm/s
CAUTION - HOT STYLUS
BATTERY
DELAY
DIAG
ALARM
EVENT
ELECTRICALLY ISOLATED ECG
PHYSIO-CONTROL
LIFEPAK 8
CARDIAC MONITOR
LOW
BATTERY
CHRG
SERVICE
DELAY
DIAG
ALARM
EVENT
ELECTRICALLY ISOLATED ECG

FIGURE 2-1. MONITOR FRONT PANEL CONTROLS AND INDICATORS

Operating and Service Manual (803195-05)
Pacing Cable (802905-02)
Pacing Cassette (802904-04)
Paddle Assembly, external, sterilizable (804507)
Patient Cable, 5 lead, replacement (9-10417-00)
Patient Cable, 5 lead, European (800948-00)
Patient Cable, 4 lead (800289-00)
Patient Cable, 3 lead (9-10418-02)
Pediatric Paddle, external (800418-00)
Pole Mount Bracket, for ECG Monitor (802807-00)
Posterior Paddle, external, adult (802461-00)
Printhead Assembly, replacement (802842-00)
Recorder Writing Stylus, replacement (801553-00)
Stylus Adjustment Tool (801470-00)
Stylus Insertion Tool, replacement (801513-00)
Stylus Replacement Kit, includes stylus insertion tool (801590-00)
Wall Mount Bracket, for ECG Monitor (802806-00)
Walsh Suction Cup Electrode, 18mm, replacement (200521-000)

2-3. CONTROLS AND INDICATORS

The following provides a brief description of the Control and Indicators on the LIFEPAK 8 Monitor, Defibrillator, and Pacing Cassette.

TABLE 2-1

MONITOR FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	ON	Push button switch turns Monitor on and off. LED illuminates when ON.
②	LEAD SELECT	Push button switch selects ECG input: Paddles, Std, Leads I, II, III, AVR, AVL, AVF, V. Monitor is automatically in Lead II when activated (in Paddles when activated by Defibrillator). Push momentarily to advance one position. Push and hold to move through selections rapidly.
③	ECG SIZE	Control adjusts vertical size of ECG trace on CRT and Recorder. A X1 gain is selected automatically at power-on. Push ▲ or ▼ to increase or decrease size.
④	FREEZE	Switch freezes the CRT display and routes real time ECG to the Recorder if it is running in DELAY mode.
⑤	ALARM SILENCE	Push to silence alarms. Alarms will remain silent for approximately one minute.

TABLE 2-1 (Continued)

MONITOR FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
⑥	LOW ALARM	Switch sets low limit for heart rate. Range is 20 - 100 BPM. Push ▲ or ▼ to increase or decrease.
⑦	HIGH ALARM	Switch sets high limit for heart rate. Range is 80 - 240 BPM. Push ▲ or ▼ to increase or decrease.
⑧	CAL	Depressing switch superimposes a 1mV calibration signal on CRT and Recorder in any lead position. Inactive in SYNC mode.
⑨	QRS VOLUME	Control adjusts volume of systole beeper. Push ▲ or ▼ to increase or decrease.
⑩	50 mm/s	Push button to select 50 mm/s speed for CRT and Recorder. Push again to return to 25 mm/s.
⑪	LOW BATTERY	Illuminated message indicates battery voltage is below normal operating level.
⑫	BATTERY	Illuminated message indicates internal battery, not ac line voltage, is the power source.
⑬	BATTERY CHRG	Illuminated message indicates battery is charging and ac power is applied.
⑭	SERVICE	Illuminated message indicates Monitor malfunction requiring service by qualified technician.
⑮	DELAY	Depressing switch places Recorder in DELAY mode. Recording is delayed 10 seconds from real time. An LED in the switch is illuminated when DELAY mode is activated.
⑯	DIAG	Depressing switch causes Recorder to be in real time diagnostic mode. When DIAG is pushed an LED in the switch is illuminated.
⑰	EVENT	If depressed while Recorder is running, an event mark will appear followed by the time and day. If not running, the Recorder will turn on for 20 seconds and annotate the recording. An LED in the switch illuminates during timed run.

TABLE 2-1 (Continued)

MONITOR FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
⑱	ALARM	Control for automatic activation of Recorder when alarm limits are violated. Records ten seconds of pre-alarm data and 10 seconds post-alarm. If Recorder is running due to an alarm, depressing switch will stop Recorder and disarm auto mode. A switch LED is illuminated when auto mode is selected.
⑲	Patient Connector	Connector for Physio-Control 6 pin Patient Cable.
⑳	Recorder	Records ECG and annotation on standard ECG paper. Prints date, time, ECG size, recording mode, lead configuration, and marks events.
㉑	Message Display	Indicates system status: PACING LEADS OFF, SYNC: USE LEADS, and PADDLE SIGNAL LOSS.
㉒	Trace	Nonfade display trace moves from right to left.
㉓	Calibrated Gain	Display indicates actual gain selected from .2 cm/mV to 4.0 cm/mV.
㉔	Lead Select Indicator	On screen indication of lead selected.
㉕	Low Alarm Indicator	On screen indication of low alarm setting.
㉖	Heart Rate	Digital display of QRS rate from 20-300 BPM.
㉗	High Alarm Indicator	On screen indication of high alarm setting.
㉘	QRS Indicator	LED Heart blinks on at each QRS detection.

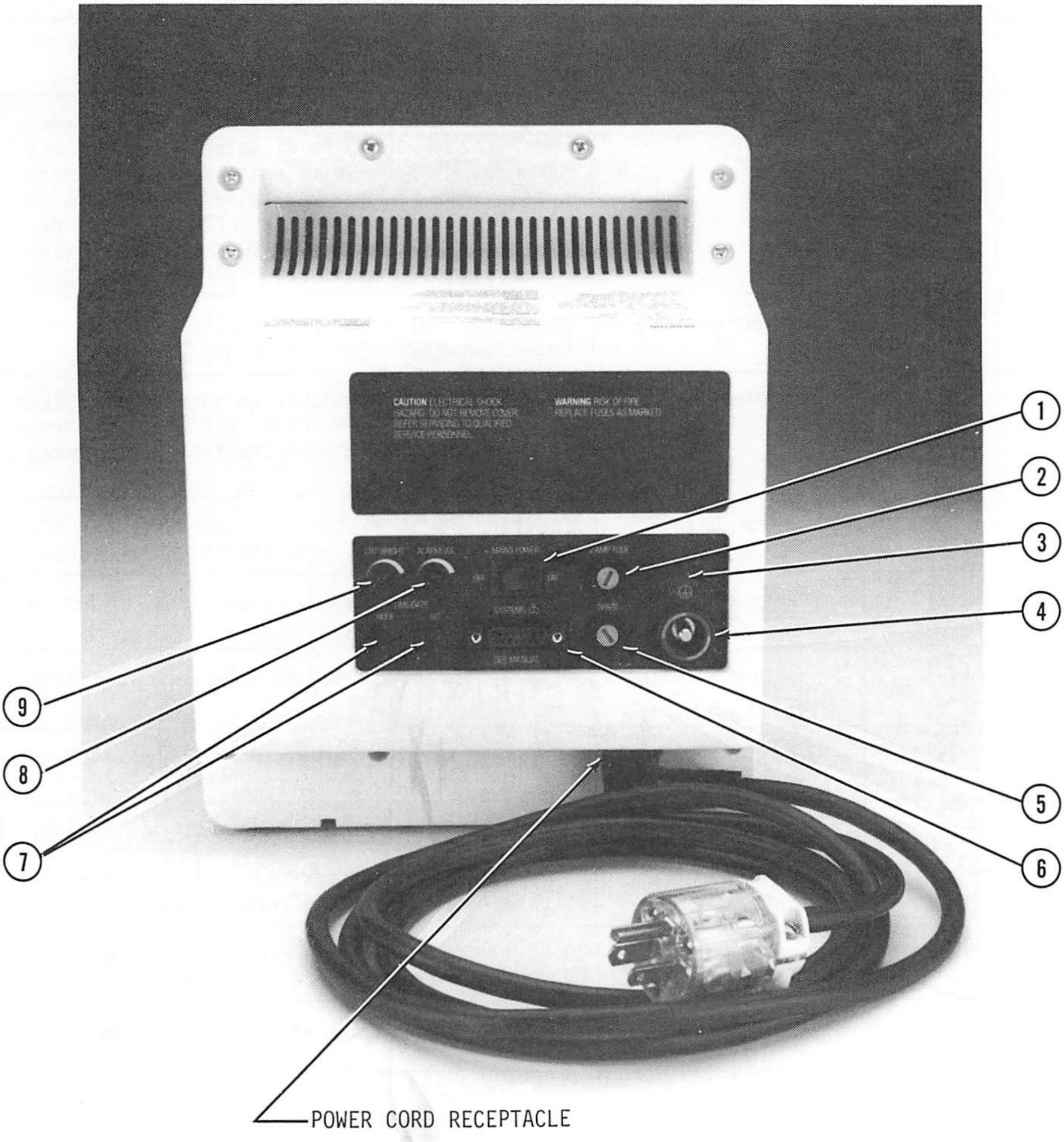
CAUTION ELECTRICAL SHOCK HAZARD. DO NOT REMOVE COVER. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
WARNING RISK OF FIRE REPLACE FUSES AS MARKED
CRT BRIGHT
ALARM VOL
MAINS POWER
OFF
ON
2 AMP FUSE
TIME/DATE
MODE
SET
SYSTEMS
SPARE
SEE MANUAL
1
2
3
4
5
6
7
8
9
POWER CORD RECEPTACLE

FIGURE 2-2. MONITOR REAR PANEL CONTROLS

©APR. 1985 PHYSIO-CONTROL

TABLE 2-2

MONITOR REAR PANEL CONTROLS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	MAINS POWER	Rocker switch to select ac line power (ON) or battery power (OFF).
②	2 AMP FUSE	Fuse for ac voltage/current overload protection.
③	Voltage 110/220	Slide switch to select line voltage. Factory preset. (Covered by label.)
④	Ground	Equipotential ground tie point.
⑤	SPARE	Storage for spare fuse in 115Vac instruments only.
⑥	SYSTEMS	Connector to interface instrument with other Physio-Control equipment or LIFEPAK 8 Defibrillator for sync interconnect via cable. Contains 1V ECG output.
⑦	TIME/DATE	Recessed push buttons for setting the real time clock.
	MODE	Causes CRT to display clock field to be updated.
	SET	Increments selected field.
⑧	ALARM VOL	Rotary control to increase or decrease volume of alarm tone. Cannot be adjusted to no tone.
⑨	CRT BRIGHT	Rotary control to adjust brightness of CRT display.

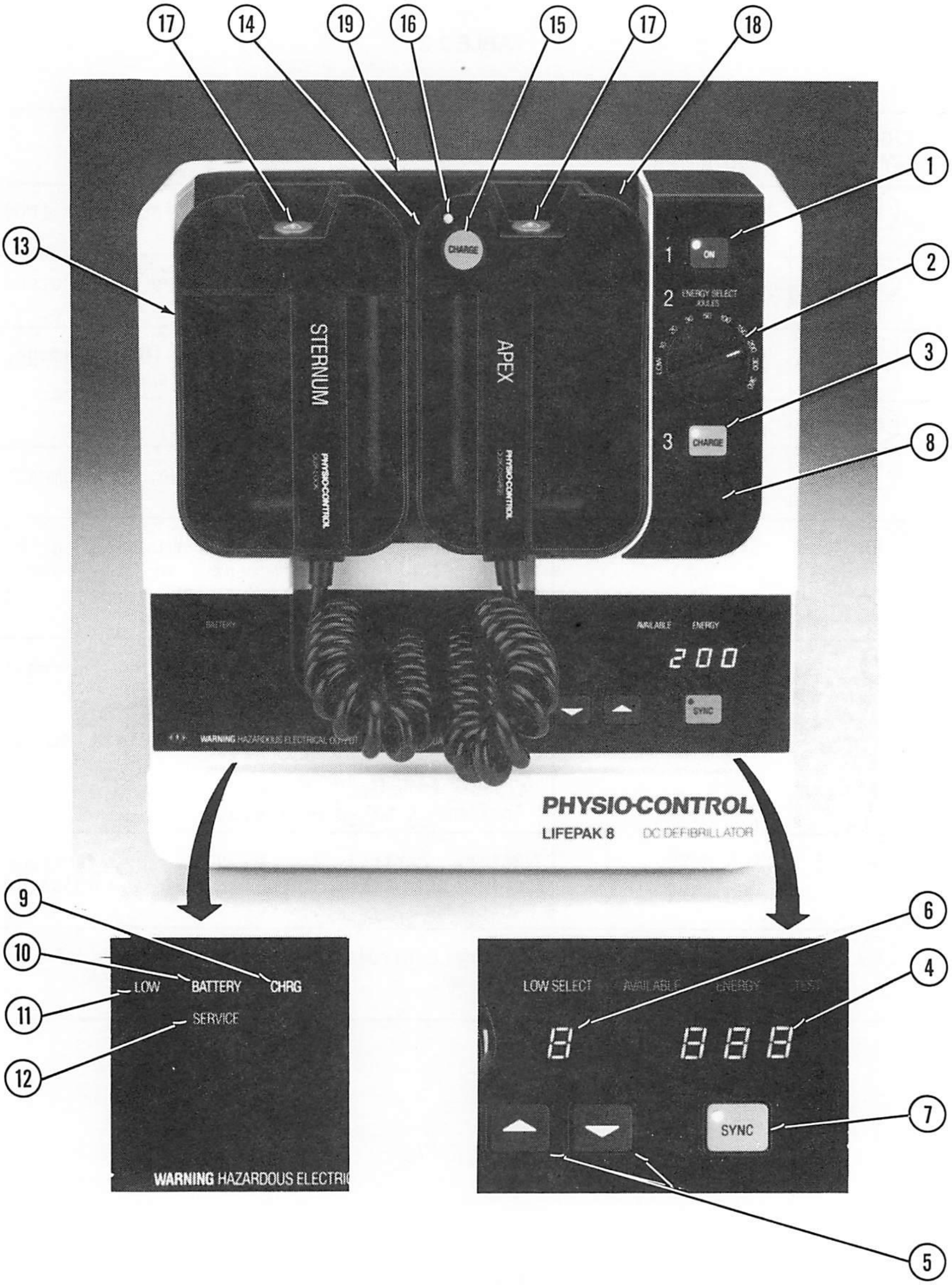
17
14
19
16
15
17
18
1
2
3
8
13
CHARGE
STERNUM
APEX
PHYSIO-CONTROL
PHYSIO-CONTROL
1
ON
2
ENERGY SELECT
JOULES
LOW
10
20
30
50
100
150
200
300
360
3
CHARGE
BATTERY
AVAILABLE
ENERGY
200
SYNC
WARNING HAZARDOUS ELECTRICAL OUTPUT
PHYSIO-CONTROL
LIFEPAK 8
DC DEFIBRILLATOR
9
10
11
12
LOW
BATTERY
CHRG
SERVICE
WARNING HAZARDOUS ELECTRIC
6
4
7
5
LOW SELECT
AVAILABLE
ENERGY
TEST
SYNC

FIGURE 2-3. DEFIBRILLATOR FRONT PANEL CONTROLS AND INDICATORS

TABLE 2-3

DEFIBRILLATOR FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	**1** ON	Main power control (push) for Defibrillator functions. Push button illuminates when power is on. Also activates Monitor when instruments are connected.
②	**2** ENERGY SELECT JOULES	Rotary switch with 10 discrete delivered energy levels: Low, 10, 20, 30, 50, 100, 150, 200, 300, and 360 joules.
③	**3** CHARGE	Momentary push button to initiate Defibrillator charge cycle. Push button LED flashes when instrument is charging, glows steadily when selected charge is reached. Charged energy is available for approximately one minute.
④	ENERGY Display Window	Window for digital display of energy being charged (numbers scroll) or fully charged (numbers steady, AVAILABLE ENERGY message illuminates). Also displays amount of energy delivered into test load when either 100J or 360J is discharged (ENERGY TEST message illuminates).
⑤	Low Energy △ ▽	Controls to adjust energy for levels between 1 and 9 joules inclusive when LOW is selected on ENERGY SELECT. 5 joules is preselected. Push △ to increase or ▽ to decrease.
⑥	LOW Energy SELECT Window	Displays selected low energy. Illuminated only when LOW is selected.
⑦	SYNC	Momentary push button switch to select synchronized mode (LED will illuminate). To return to defibrillate (asynchronous) mode, depress button again.
⑧	SYNC MODE	Message illuminates when sync mode is selected. Message flashes with each detected QRS. **NOTE:** Defibrillate mode is automatically selected when Defibrillator is activated and ENERGY SELECT is set to any energy level. Defibrillator automatically returns to defibrillate mode after each synchronous discharge.

TABLE 2-3 (Continued)

DEFIBRILLATOR FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
⑨	BATTERY CHRG	Illuminated message indicates battery is charging and that power source is ac line.
⑩	BATTERY	Illuminated message indicates that power source is the internal battery.
⑪	LOW BATTERY	Illuminated message indicates battery power is low.
⑫	SERVICE	Illuminated message indicates system malfunction requiring service attention.
PADDLES AND STORAGE AREA		
⑬	STERNUM Paddle	Defibrillating electrode with one discharge push button, usually placed to left of sternum (patient's right). Also serves as negative ECG electrode during QUIK-LOOK paddle monitoring.
⑭	APEX Paddle	Defibrillating electrode with QUIK-CHARGE control (CHARGE) and second discharge push button, usually placed near cardiac apex. Also serves as positive ECG electrode during QUIK-LOOK paddle monitoring.
⑮	CHARGE (QUIK-CHARGE control)	Momentary push button to charge Defibrillator from APEX paddle.
⑯	Charge Indicator	Illuminated indicator flashes during charge cycle and glows steadily when energy has reached preselected level.
⑰	Discharge Push buttons	Push buttons to discharge Defibrillator. Both buttons must be depressed simultaneously to deliver energy to the paddles. ENERGY WILL NOT BE DELIVERED UNLESS THE DEFIBRILLATOR IS FULLY CHARGED TO PRESELECTED LEVEL. (Numbers in Energy Display window on steadily, AVAILABLE ENERGY illuminated, and Charge Indicator illuminated steadily.)
⑱	Test Load (Under Paddles)	50 ohm Defibrillator test load. Metal contacts for receiving defibrillation pulse from paddles.
⑲	Cassette Receptacle	Receptacle for cassette which allow use of auxiliary paddles or pacing.

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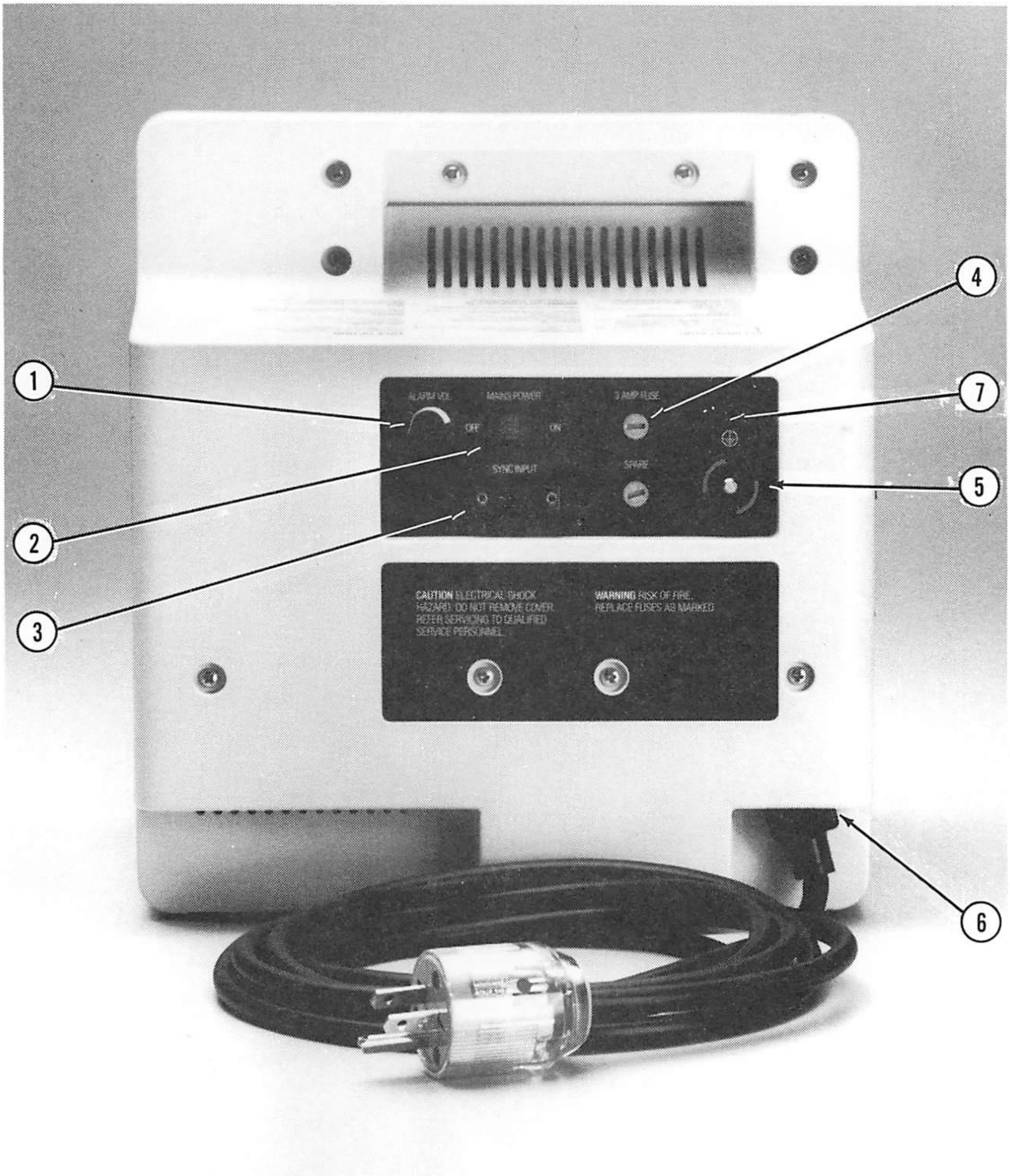
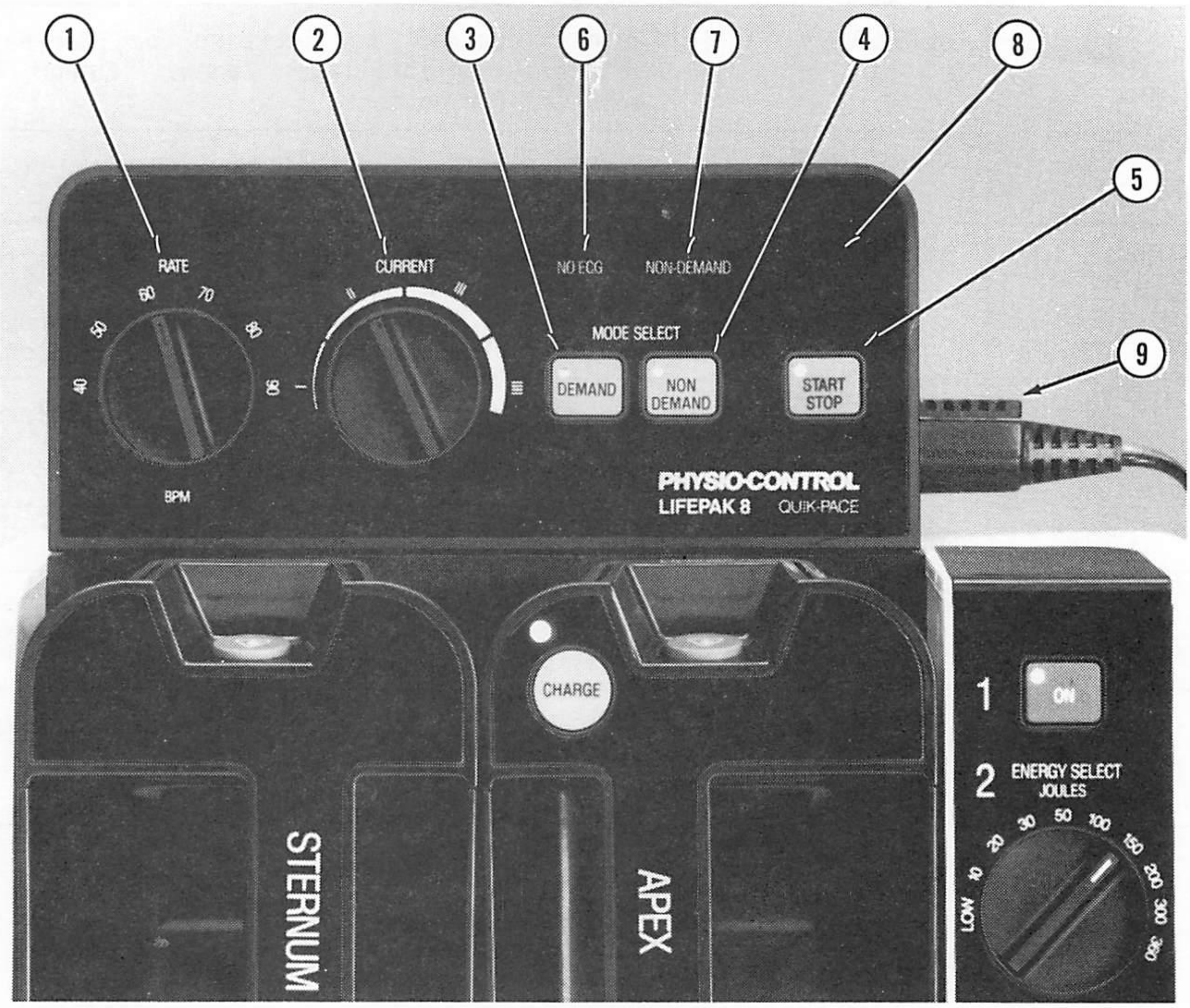

1
2
3
4
5
6
7
ALARM VOL
MAINS POWER
OFF
ON
3 AMP FUSE
SYNC INPUT
SPARE
CAUTION ELECTRICAL SHOCK HAZARD. DO NOT REMOVE COVER. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
WARNING RISK OF FIRE. REPLACE FUSES AS MARKED.

FIGURE 2-4. DEFIBRILLATOR REAR PANEL CONTROLS

TABLE 2-4

DEFIBRILLATOR REAR PANEL CONTROLS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	ALARM VOL	Rotary control to increase or decrease volume of Defibrillator tones. Cannot be adjusted for no tone.
②	MAINS POWER	Rocker switch to select ac line power (ON) or battery power (OFF).
③	SYNC INPUT	Auxiliary connection for cable to Monitor for SYNC capacity. (Necessary only when LIFEPAK 8 Monitor is not joined through latching fin assembly to Defibrillator.)
④	3 AMP FUSE SPARE	AC voltage/current overload protectors. Domestic only.
⑤	Ground	Equipotential ground tie point.
⑥	Power Cord	Connect to grounded ac receptacle. Check that label on bottom of instrument matches available voltage/frequency.
⑦	VOLTAGE Selector	Slide switch to select 110Vac or 220Vac line power. (Under label.)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2
3
6
7
4
8
5
9
RATE
40
50
60
70
80
90
BPM
CURRENT
I
II
III
IIII
NO ECG
NON-DEMAND
MODE SELECT
DEMAND
NON DEMAND
START STOP
PHYSIO-CONTROL
LIFEPAK 8
QUIK-PACE
CHARGE
STERNUM
APEX
1
ON
2
ENERGY SELECT JOULES
LOW
10
20
30
50
100
150
200
300
360

FIGURE 2-5. PACING CASSETTE FRONT PANEL CONTROLS AND INDICATORS

TABLE 2-5

PACING CASSETTE FRONT PANEL CONTROLS AND INDICATORS

FIGURE KEY NO.	CONTROL OR INDICATOR	FUNCTION
①	RATE BPM	Rotary switch to select pacing rate: 40, 50, 60, 70, 80, or 90 beats per minute.
②	CURRENT (mA)	Continuous rotary control to select pacing current in milliamps (mA). Current adjustable from zero to 200 mA divided into four ranges labeled **I**, **II**, **III**, **IIII**.
③	DEMAND (MODE SELECT)	Momentary push button control to select demand mode pacing (LED illuminated when selected). Pacing is available only when the Monitor and Defibrillator are connected and an ECG signal is available. Push again to turn off. (START STOP must be off to change modes.)
④	NON DEMAND (MODE SELECT)	Momentary push button control to select nondemand, fixed rate pacing (LED and NON-DEMAND illuminated when selected.) Pacing is available only when the Monitor and Defibrillator are connected and an ECG signal is available. Push again to turn off. (START STOP must be off to change modes.)
⑤	START STOP	Momentary push button control to start and stop delivery of pacing stimuli through disposable pacing electrodes. Push button LED is illuminated when on and blinks off with each pulse actually delivered.
⑥	NO ECG	Message illuminates when a pacing mode is selected and no ECG is sensed or, ECG signal is lost after pacing has started.
⑦	NON-DEMAND	Message illuminates when NON DEMAND mode is selected.
⑧	TEST	Message illuminates when pacing current is dissipated internally (test mode, no pacing cable attached to cassette).
⑨	Pacing Cable Connector	Cable connector for attaching QUIK-PACE disposable pacing electrodes.

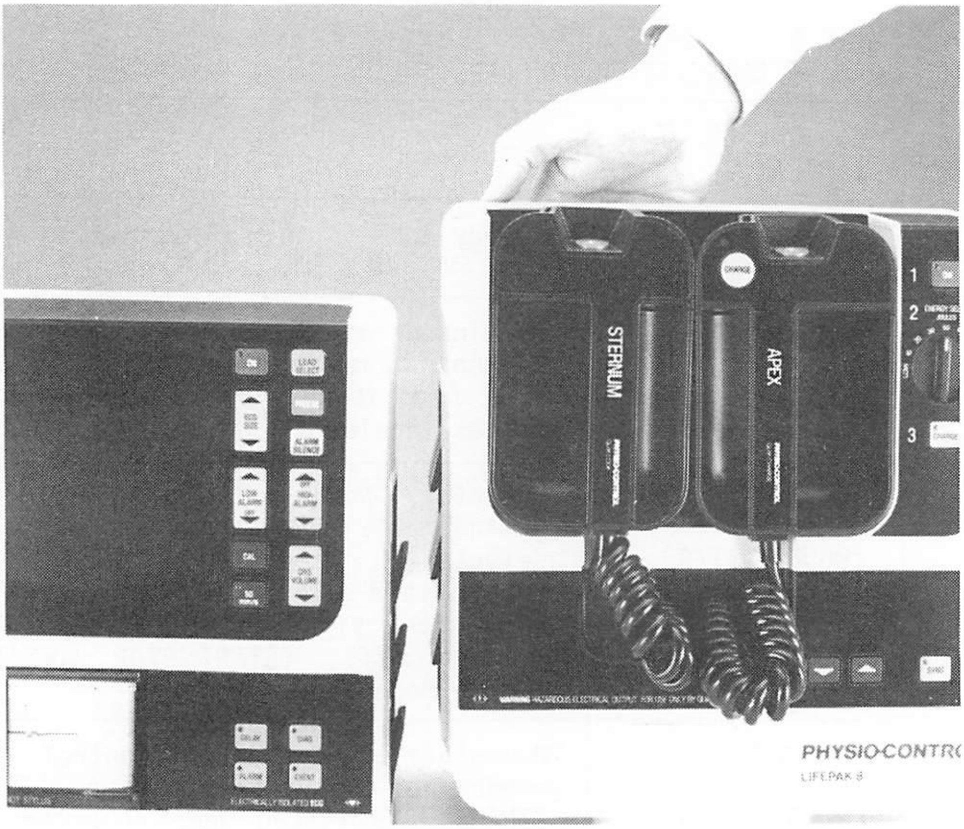


FIGURE 2-6. CONNECTING THE INSTRUMENTS

2-4. CONNECTING THE INSTRUMENTS

The LP 8 Monitor is connected to the Defibrillator mechanically and electrically by fins. To connect the instruments, hold the Defibrillator above the Monitor as pictured. Lower the Defibrillator so that the fins mate appropriately.

The Monitor can also be connected to the Defibrillator or other Physio-Control instruments by an accessory cable for sync capability.

To separate the instruments, the safety latch on the top surface of the Defibrillator must be disengaged. Depress the recessed button then lift the Defibrillator. See Figure 2-6.

NOTE: The instruments will not separate if any weight is being born by the connector. Both modules must be supported on an even surface.

2-5. PERIODIC SERVICE PROCEDURES

To ensure accurate measurements, the test and calibration procedures for the LIFEPAK 8 Monitor, Defibrillator, and Pacing Cassette should ideally be performed at three month intervals. In addition, replacement of components may necessitate adjustment of the affected circuits. The procedures in Section 3 can be helpful in localizing certain malfunctions that exist in the system and in insuring that the product is operating as intended.

Suggested Performance Verification Procedures (PVPs) and Checklists for the LP 8 System, the Monitor, the Defibrillator, and the Pacing Cassette are included in the following paragraphs. The Checklists are provided for the customer's use and may be copied when needed.

CAUTION

THESE INSTRUMENTS ARE TO BE SERVICED BY PERSONS QUALIFIED BY TRAINING OR EXPERIENCE ONLY.

DO NOT DISCHARGE DEFIBRILLATOR WITH PADDLES SHORTED TOGETHER.

FOR SAFETY, DO NOT CONNECT ACCESSORY EQUIPMENT TO THE SYSTEMS CONNECTOR UNLESS ACCESSORY EQUIPMENT IN COMBINATION WITH LIFEPAK 8 HAS BEEN EVALUATED FOR FIRE AND SHOCK HAZARD.

2-6. LIFEPAK 8 SYSTEM PERFORMANCE VERIFICATION PROCEDURE (See Fig. 2-7.)

The following items are needed to complete the System PVP:

EQUIPMENT REQUIRED	PART NUMBER OR SPECIFICATION
ECG Simulator	PCC SVC-T-500
Patient Cable	PCC 9-10417 or 800948

1. PHYSICAL INSPECTION.

   Perform a complete physical inspection of the Monitor, Defibrillator and Pacing Cassette. Check for loose or missing knobs and hardware, cracks, dents, damaged labels and contamination from foreign substances. Clean optical interface windows, paddles and paddle storage receptacle with a soft cloth and water if necessary. Connect the Monitor and Defibrillator via the mechanical fin assembly. Insure that the latch mechanism provides a secure connection between the two instruments.

   Insert the Pacing Cassette into the Defibrillator. Connect ac line power to the Monitor and Defibrillator. Set the rear panel ac MAINS switches to ON or (I).

2. WAKE-UP.

   Depress the Defibrillator power ON push button. Verify that following a 10 second self-test, the Monitor and Defibrillator power-on in the following manner:

MONITOR:

A. PADDLES is selected. (Monitor may be set so that Lead II is selected. See paragraph 3-5.)

B. ECG size is X1.0.

C. Recorder is off (will run briefly during self-test).

D. Heart rate alarms are off.

DEFIBRILLATOR:

A. AVAILABLE ENERGY is 0.

B. Sync is inactive.

C. Low energy digit is blank (unless low is selected).

PACING CASSETTE:

A. LEDs and Legends illuminate for approximately the same amount of time as the Monitor and Defibrillator indicators.

B. LEDs and Legends extinguish and Pacing Cassette is in the Standby mode.

3. WAKE-UP SUPPRESSION.

Depress Monitor ON push button to turn Monitor off. Verify that the Monitor turns off and remains off. Turn Defibrillator off by depressing the Defibrillator ON push button.

4. PADDLES ACTIVATION.

Depress the Monitor ON push button and verify that PADDLES (or Lead II, see 2A above) is selected and ECG size is X1.0.

A. Depress and hold the LEAD SELECT push button and verify that PADDLES can be selected.

B. Input an ECG through the paddles (place right hand on STERNUM paddle electrode plate, left hand on APEX paddle electrode plate) and verify that the CRT displays a positive going QRS waveform.

C. Depress Defibrillator ON push button. Adjust Monitor ECG SIZE to X1.2. Fill the screen with noise by intermittently shorting the paddles together. Short and hold the paddles together and verify that the trace recovers to less than or equal to 1mm p-p within 2 seconds.

D. Disconnect the Defibrillator from the Monitor and rotate the Defibrillator approximately 90 degrees. Verify that the PADDLE SIGNAL LOSS is steadily on in the lower left corner of the CRT. Reconnect the Defibrillator to the Monitor.

5. SYNCHRONIZED CARDIOVERSION.

Depress the Defibrillator SYNC push button and verify that "SYNC: USE LEADS" flashes in the lower left corner of the CRT.

Using an ECG simulator, input a 60 BPM ECG via the Patient Cable.

Depress the LEAD SELECT push button and obtain an ECG in any active patient lead. (Use ECG size as necessary to obtain systole detection.)

Depress the Defibrillator SYNC push button and verify that SYNC is activated by the following:

A. The Defibrillator SYNC and MODE legends, and SYNC push button LED illuminate.

B. SYNC legend and SYNC push button LED blink off when an R wave is detected.

C. SYNC marks appear on R waves on the CRT.

D. Depress the SYNC push button off and back on again. Verify that SYNC switches off and then back on.

NOTE: Pacing Cassette must be removed from defibrillator prior to discharge into test load.

With the paddles stowed in the paddle storage receptacle, select 100J and depress the CHARGE push button. Upon completion of the charge cycle, depress the Recorder DELAY push button. Then depress and hold both paddle discharge push buttons. Verify the following:

E. Discharge does not occur until the SYNC legend blinks.

F. ENERGY TEST illuminates and 100J is displayed.

G. SYNC and MODE legends and SYNC push button LED extinguish.

H. SYNC marks are no longer displayed on R waves.

I. Recorder annotates " ▼ HR:MM DDMONYR @ 100 JOULES SYNC".

Depress the DELAY push button to turn the Recorder off.

6. PACING OPERATION.

Adjust the RATE on the Pacing Cassette to 70 BPM and CURRENT to I. Adjust Monitor ECG SIZE to X1.0. Depress the DEMAND push button.

A. Verify that sync markers appear on R waves on the CRT.

B. Depress the START STOP push button. Verify that the START STOP LED is flashing.

C. Verify that pacing spikes appear on the CRT (pacing spikes may be positive or negative going.)

D. Depress the DELAY push button on the Monitor. Verify that the Recorder is running. Verify that after several seconds the Recorder annotates "HR:MM DDMONYR DEMAND PACE @ 70, LEVEL I SELECT. LEAD II X1.0 HR=---".

E. Turn off the Recorder. Verify that a pacing spike is recorded and a pacing mark (↓) was annotated in the margin within 0.5mm of each pacing spike. Depress the START STOP and then the DEMAND push buttons.

DATE ________

FIGURE 2-7. LIFEPAK 8 SYSTEM PERFORMANCE VERIFICATION CHECKLIST

1. PHYSICAL INSPECTION.. ____

2. WAKE-UP

MONITOR:

A. PADDLES (Lead II) Selected.................................... ____
B. ECG Size X1.0.. ____
C. Recorder Off... ____
D. Heart Rate Alarms Off.. ____

DEFIBRILLATOR:

A. AVAILABLE ENERGY 0... ____
B. SYNC Inactive.. ____
C. Low Energy Digit Blank... ____

PACING CASSETTE:

A. LEDs and Legends Illuminate.................................... ____
B. LEDs and Legends Extinguish, Pacing Cassette in Standby Mode..... ____

3. WAKE-UP SUPPRESSION Monitor Remains Off............................. ____

4. PADDLES ACTIVATION

A. PADDLES Selected... ____
B. Positive Polarity.. ____
C. Paddles Recover within 2 Seconds............................... ____
D. PADDLE SIGNAL LOSS Appears on CRT.............................. ____

5. SYNCHRONIZED CARDIOVERSION

A. Sync, Mode, and Sync LED Illuminated........................... ____
B. R Wave Detection Blink... ____
C. Sync Marks on R Waves.. ____
D. Sync Off and On.. ____
E. Discharge at Sync Blink.. ____
F. Energy Test and 100J Displays.................................. ____
G. SYNC, MODE, and SYNC LED Extinguishes.......................... ____
H. No Sync Marks on R Waves....................................... ____
I. Recorder Annotates " ▼ HR:MM DDMONYR @ 100 JOULES SYNC"......... ____

6. PACING OPERATION

A. Sync Marks on R Waves.. ____
B. START STOP LED Flashes... ____
C. Pacing Spikes Appear on CRT.................................... ____
D. Recorder Annotates "HR:MM DDMONYR DEMAND PACE..."............... ____
E. Pacing Spikes and Pacing Marks Recorded........................ ____

2-7. **LIFEPAK 8 MONITOR PERFORMANCE VERIFICATION PROCEDURE** (See Figure 2-8.)

The following items are needed to complete the Monitor PVP:

EQUIPMENT REQUIRED	PART NUMBER OR SPECIFICATION
ECG Simulator	SVC-T-500
Patient Cable	PCC 9-10417
Function Generator	Kronhite Model 5400A or equivalent

1. PHYSICAL INSPECTION.

   Perform a complete physical inspection of the Monitor; checking for loose or missing knobs/hardware, cracks, dents, damaged labels and contamination from foreign substances.

   Connect ac line power to the Monitor.
   Set the rear panel MAINS POWER push button to OFF or (0).

2. BATTERY STATUS INDICATORS.

   A. Press the Monitor ON push button and verify that the BATTERY legend illuminates.

   B. Set the rear panel MAINS POWER push button to ON or (I). Verify that BATTERY CHRG is illuminated.

   Press Monitor ON push button again to turn power off.

3. POWER-ON SELF-TEST.

   Press the Monitor ON push button and verify completion of a ten second test routine:

   A. All LEDs illuminate for two seconds.

   B. Recorder runs, annotates the arrow symbol (▼), time, date, "DIAG. X1.0", and traces a CAL pulse.

   C. ECG size is set at X1.0.

   D. Lead II is selected.

   E. Sweep speed is 25mm/second.

   F. QRS volume is 10% above minimum.

   G. Recorder is off.

   H. Alarms are off.

4. CRT DISPLAY.

   Using an ECG simulator, input a 60 BPM ECG to the Patient Cable.

Verify that the CRT display meets the following requirements:

A. Analog trace is linear, focused, and R waves are spaced 25mm apart.

B. Alphanumeric field is focused and linear.

C. Display intensity is variable via the rear panel adjustment.

Turn Monitor power off.

5. CONTROLS AND INDICATORS.

Verify that the conditions listed for each control setting outlined below:

A. ON - Press the ON push button. Monitor powers up and an LED in the push button illuminates.

B. LEAD SELECT - Press the LEAD SELECT push button. The next lead setting is selected and displayed on the CRT.

Depress the LEAD SELECT push button and hold. Lead settings are successively selected at 0.5 second intervals. PADDLES is not displayed. Select Lead II and continue.

C. FREEZE - Press the FREEZE push button. The analog display will freeze.

D. ECG SIZE - Successive closures of this push button will increase (▲) or decrease (▼) the ECG size from X0.2 through X4.0 in .2 increments (X0.5 is also available).

Holding this push button depressed causes the ECG size to scroll up or down to its limit.

Adjust ECG size to detect the simulated ECG input.

E. QRS VOLUME - Successive closures of this push button will increase (▲) or decrease (▼) the QRS volume.

Holding this push button depressed causes QRS volume to increase or decrease to its limits within two seconds.

Set QRS volume to minimum (OFF).

F. ECG ALARMS - Depress the HIGH ALARM ▼ push button once. Verify that 240 appears in the alphanumeric field above the heart rate field.

Depress and hold the HIGH ALARM ▼ push button. Verify that the HIGH limit scrolls down through the following settings: 220, 200, 190, 180, 170, 160, 150, 140, 130, 120, 110, 100, 90, 80.

Press HIGH ALARM ▲ and set the high limit at 180.

Press the Recorder ALARM push button. Verify that an LED in the push button illuminates.

Input a 180 BPM ECG from the ECG simulator. Verify that a two-tone alarm sounds upon alarm limit violation and that the Recorder runs for 20 seconds in DELAY.

Press the ALARM SILENCE push button. Verify that alarm tones are silenced for 64 ± 4 seconds.

Verify that high alarm limit flashes.

Adjust the rear panel ALARM VOLUME through its range. Verify that the volume at minimum is 10% of its maximum volume.

Set the HIGH ALARM limit to OFF. Verify that the high limit alphanumerics blank.

Press the LOW ALARM ▲ push button once. Verify that 20 appears in the alphanumeric field below the heart rate field.

Depress and hold the LOW ALARM ▲ push button. Verify that the low limit scrolls up through the following settings: 25, 30, 35, 40, 45, 50, 55, 60, 70, 80, 90, 100.

Press LOW ALARM ▼ and set the low limit at 60.

Input a 60 BPM ECG. Verify that a two-tone alarm sounds upon alarm limit violation and that the Recorder runs in DELAY.

Verify that pressing the ALARM push button causes the Recorder to stop and ALARM LED to turn off.

Set the LOW ALARM to OFF. Verify that low limit alphanumerics blank and the alarm tone ceases.

G. 50mm/s - Verify that closure of this push button toggles the CRT and Recorder between 25 and 50mm/s sweep speeds. An LED in this push button illuminates when 50mm/s is selected.

Press the 50mm/s switch to reset sweep speed to 25mm/s.

6. RECORDER.

Using a function generator, input a 10Hz, 1mV sine wave to the Patient Cable. Select Lead II. Set ECG size to X1.0.

A. DIAG - Activation of this push button causes the Recorder to run. A 1cm sine wave is printed. An LED in the push button illuminates when DIAG mode is selected.

Verify that the waveform is clearly printed.

Verify that time and date are accurate.

Press the EVENT push button and verify that an event marker (▼) appears in the upper paper margin within 2.5 seconds.

Press DIAG to turn the Recorder off.

B. DELAY - Activation of this push button causes the Recorder to run. A 1cm sine wave is printed that is delayed 10 seconds in the 25mm/s mode (5 seconds in 50mm/s mode). An LED in the push button illuminates when DELAY mode is selected.

Closure of the 50mm/s push button causes maximum deflection of the analog stylus for 5 seconds (10 seconds for 25mm/s).

Select 25mm/s Recorder speed.

Frequency Response in DELAY record mode - By adjusting the function generator and verify that the 10mm p-p deflection at 10Hz does not drop below 7mm p-p or exceed 11mm p-p from 1.0Hz to 30Hz (or 0.3Hz to 30Hz for international instruments).

Frequency Response in DIAG record mode - Adjust the function generator, to 10Hz, verify that a 5mm p-p deflection does not drop below 3.5mm p-p from 0.05Hz to 100Hz.

Press the FREEZE push button. Verify that diagnostic ECG is routed to the Recorder and that the DIAG LED illuminates. (FREEZE LED turns off simultaneously.)

Press DELAY to turn the Recorder off.

C. EVENT - Pressing this push button causes the Recorder to run for 20 ± 1 seconds in DELAY. Verify that a pre-event message prints immediately, followed in ten seconds by the event message. LEDs in this push button and in the DELAY push button illuminate during the timed run.

D. CAL - Pressing this push button places a 1cm pulse on the Recorder trace. Set LEAD SELECT to STD. Press DIAG to activate Recorder. Press CAL and verify the presence of a 10mm ± 0.5mm pulse above baseline on the Recorder.

7. LEAKAGE.

Check ac leakage in accordance with AAMI/ANSI 3.2.1.22.

A. Chassis Leakage - less than 100μA (typically less than 40μA).

B. Ground Resistance - .15 Ω or less.

Turn Monitor power OFF. This completes the Monitor Performance Verification Procedure.

DATE ________

FIGURE 2-8. LIFEPAK 8 MONITOR PERFORMANCE VERIFICATION CHECKLIST

1. PHYSICAL INSPECTION.. ____

2. BATTERY STATUS INDICATORS

   A. BATTERY illuminates.. ____
   B. BATTERY CHRG illuminates.. ____

3. POWER-ON SELF-TEST

   A. All LEDs illuminate.. ____
   B. Recorder runs, annotates.. ____
   C. ECG size set at X1.0.. ____
   D. Lead II is selected.. ____
   E. Sweep speed is 25mm/s.. ____
   F. QRS volume 10% above minimum.. ____
   G. Recorder off.. ____
   H. Alarms off.. ____

4. CRT DISPLAY

   A. Trace linear, focused.. ____
   B. Alphanumeric linear, focused.. ____
   C. Display intensity variable.. ____

5. CONTROLS AND INDICATORS

   A. ON-Monitor powers-on.. ____
   B. LEAD SELECT-leads displayed.. ____
   C. FREEZE-analog display.. ____
   D. ECG SIZE-from X0.2 to X4.0.. ____
   E. QRS VOLUME-adjustable.. ____
   F. ECG ALARMS:
      240 appears in field.. ____
      Scrolls from 220 to 80.. ____
      ALARM push button LED illuminates.. ____
      Alarm sounds, Recorder runs.. ____
      ALARM SILENCE functions.. ____
      High alarm limit flashes.. ____
      ALARM VOLUME adjustable.. ____
      HIGH ALARM off, blanks.. ____
      20 appears in field.. ____
      Scrolls from 25 to 100.. ____
      Alarm sounds, Recorder runs.. ____
      ALARM push button stops Recorder.. ____
      LOW ALARM off, blanks display.. ____
   G. 50mm/s-toggles sweep speed.. ____

DATE ______

FIGURE 2-8. LIFEPAK 8 MONITOR PERFORMANCE VERIFICATION (Continued)
CHECKLIST

6. RECORDER

   A. DIAG:
      Recorder runs.. ____
      Waveform already printed... ____
      Time and date accurate... ____
      Event marker appears... ____
   B. DELAY:
      5(10) second stylus deflection................................... ____
      DELAY frequency response correct................................. ____
      DIAG frequency response correct.................................. ____
      FREEZE routes real time to Recorder.............................. ____
   C. EVENT-20 second run with annotated messages...................... ____
   D. CAL-10mm ± 0.5mm pulse... ____

7. LEAKAGE

   A. Chassis Leakage (≤ 100μA)....................................... ____μA
   B. Ground Resistance (.15Ω or less)................................. ____Ω

2-8. **LIFEPAK 8 DEFIBRILLATOR PERFORMANCE VERIFICATION PROCEDURE** (See Figure 2-9.)

The following items are needed to complete the Defibrillator PVP:

EQUIPMENT REQUIRED	PART NUMBER OR SPECIFICATION
Energy Meter	Load Resistance: 50 ohms +0.5%
Stopwatch	Accuracy: ±0.25 seconds

1. PHYSICAL INSPECTION.

   Perform a complete physical inspection of the Defibrillator. Check for loose knobs or hardware, cracks, dents, damaged labels and contamination from foreign substances. Pay particular attention to the paddles and the Defibrillator storage compartment.

   Connect ac line power to the Defibrillator.
   Set the rear panel MAINS POWER switch to OFF or (O).

2. BATTERY STATUS INDICATORS.

   A. Depress the Defibrillator ON push button and verify that the BATTERY legend illuminates.

   B. Set the rear panel MAINS POWER switch to ON or (I) and verify that the BATTERY CHRG legend illuminates.

   Depress ON to turn Defibrillator off.

3. POWER-ON SELF-TEST.

   Depress the Defibrillator ON push button and verify that all displays are illuminated for two seconds at power-on.

   A. Verify that the green ON LED, the BATTERY CHRG legend and the AVAILABLE ENERGY legend remain illuminated and the AVAILABLE ENERGY display is blank unless LOW is selected. In this case, LOW energy displays the digit 5.

   B. Verify that the SYNC legend is off.

4. LOW ENERGY SELECT.

   A. Set ENERGY SELECT to LOW and verify that the LOW SELECT legend is illuminated and the digit 5 is displayed.

Depress and hold the low energy increase push button (△) and verify that the LOW SELECT digit increments sequentially; stopping at 9.

Depress and hold the low energy decrease push button (▽) and verify that the LOW SELECT digit decrements sequentially; stopping at 1.

5. DELIVERED ENERGY.

Connect the Defibrillator paddles to an energy meter with an integral 50 ohm load.

Depress the APEX paddle CHARGE push button and verify the following:

A. An audible whine sounds and the ENERGY legend illuminates indicating that the Defibrillator is charging.

B. The front panel and APEX paddle CHARGE LEDs blink during charge.

When the Defibrillator reaches full charge, verify the following:

C. Charge termination is accompanied by a short beep.

D. The front panel and APEX paddle CHARGE LEDs remain steadily on.

E. AVAILABLE is illuminated and selected energy is displayed.

F. Depress both paddle discharge push buttons simultaneously and verify that the energy delivered is 1 joule ±.1.

G. Repeat this procedure for each of the following ENERGY SELECT settings:

ENERGY	TOLERANCE
2J	± .2J
3J	± .3J
4J	± .4J
5J	± .5J
6J	± .6J
7J	± .7J
8J	± .8J
9J	± .9J
10J	± 1J
20J	± 2J
30J	± 3J
50J	± 5J
100J	± 6J
150J	± 9J
200J	± 12J
300J	± 18J
360J	± 22J

H. Verify that the charge may be initiated using the front panel CHARGE push button.

Discharge the Defibrillator into the energy meter.

6. CHARGE TIME AND REFRESH.

A. Set ENERGY SELECT to 360 joules. Simultaneously initiate charge and start the stopwatch. Verify that the Defibrillator charge time from 0-360 joules is 9.0 to 9.5 seconds.

B. Verify that AVAILABLE ENERGY is maintained for 64 ± 4 seconds from charge termination. Refresh occurs periodically during this period.

C. Verify that after the refresh period is complete, AVAILABLE ENERGY and CHARGE indicators are extinguished.

D. Press either the Defibrillator or the APEX paddle CHARGE push button and verify that the selected energy is rapidly restored.

WARNING

DURING OPEN AIR DISCHARGES, LETHAL VOLTAGES ARE PRESENT ON THE PADDLE ELECTRODES.

E. Hold the paddles apart (at least one foot) in open air and depress both discharge push buttons simultaneously. Verify that the display flashes at a 1 Hz rate, ENERGY is illuminated, and that the conditions continue until CHARGE is depressed.

Upon termination of charge, discharge the Defibrillator into the energy meter.

7. TEST LOAD.

Place paddles in the Defibrillator storage receptacle.

NOTE: Pacing Cassette must be removed from defibrillator prior to discharge into test load.

Rotate the ENERGY SELECT switch to 100J and depress CHARGE. Upon termination of the charge cycle, verify the following:

A. AVAILABLE ENERGY is illuminated.

B. ENERGY display indicates 100.

Depress both DISCHARGE push buttons and verify the following:

C. ENERGY TEST is illuminated for 20 seconds or until CHARGE is pressed.

D. ENERGY display indicates 100 for 20 seconds or until CHARGE is pressed.

8. LEAKAGE.

Check ac leakage in accordance with AAMI/ANSI 3.2.1.22.

A. Chassis Leakage: Less than 100μA.

B. Paddle Source Current: Less than 20μA.

C. Paddle Sink Current: Less than 20μA.

Depress ON push button to turn the Defibrillator power off. This completes the Defibrillator performance verification procedure.

DATE ________

FIGURE 2-9. LIFEPAK 8 DEFIBRILLATOR PERFORMANCE VERIFICATION CHECKLIST

1. PHYSICAL INSPECTION.. ______

2. BATTERY STATUS INDICATORS

   A. BATTERY Illuminated.. ______
   B. BATTERY CHRG Illuminated.. ______

3. POWER-ON SELF-TEST

   A. ON LED, BATTERY CHGR, AVAILABLE ENERGY Illuminated................ ______
   B. SYNC legend Off.. ______

4. LOW ENERGY SELECT

   A. LOW SELECT Illuminated, 5 Joules Displayed........................ ______

5. DELIVERED ENERGY

   A. Defibrillator Charges.. ______
   B. CHARGE LEDs Blink.. ______
   C. Short Beep Following Full Charge................................ ______
   D. CHARGE LEDs Remain On.. ______
   E. AVAILABLE Illuminated, Selected Energy Displayed................ ______
   F. ENERGY Displays 1 ±.1 Joule.. ______
   G.

Selected	2	3	4	5	6	7	8	9	10	20	30	50	100	150	200	300	360
Delivered																	

   H. Charges From Front Panel.. ______

6. CHARGE TIME AND REFRESH

   A. Reached 360 Joules in 9 to 9.5s................................ ______
   B. AVAILABLE ENERGY Maintained for 64 ±4s............................ ______
   C. AVAILABLE ENERGY and CHARGE extinguished........................ ______
   D. AVAILABLE ENERGY Restored Rapidly................................ ______
   E. Display Flashes, ENERGY Illuminated................................ ______

7. TEST LOAD

   A. AVAILABLE ENERGY Illuminated.. ______
   B. 100 Displayed.. ______
   C. ENERGY TEST Illuminated for 20s................................ ______
   D. 100 Displayed for 20s.. ______

8. LEAKAGE

   A. Chassis Leakage (≤ 100μA).. ______μA
   B. Paddle Source Current (≤ 20μA)................................ ______μA
   C. Paddle Sink Current (≤ 20μA)................................ ______μA

2-9. PACING CASSETTE PERFORMANCE VERIFICATION PROCEDURE

(See Figure 2-10.)

The following items are needed to complete the Pacing Cassette PVP:

EQUIPMENT REQUIRED	PART NUMBER OR SPECIFICATION
ECG Simulator	PCC SVC-T-500
Patient Cable	PCC 9-10417 or 800948
Pacing Cable	PCC 802905
Storage Oscilloscope	Tektronix 465 or equivalent
Resistor	50 Ω, 1/4W

1. PHYSICAL INSPECTION.

   Perform a complete physical inspection of the Pacing Cassette. Check for loose knobs or hardware, cracks, dents, damaged labels and contamination from foreign substances. Pay particular attention to the paddles connector.

   Connect the LIFEPAK 8 Monitor and Defibrillator through the fin connector and install the Pacing Cassette in its operating position. Do not connect the Pacing Cable.

2. POWER-ON.

   Depress the Defibrillator ON push button. Verify that the Monitor and Defibrillator power-on according to the system performance verification procedure and that all Pacing Cassette LEDs and legends illuminate for approximately the same amount of time as the Monitor and Defibrillator indicators.

3. R WAVE DETECTION.

   Use an ECG simulator to input a 45 BPM NSR waveform to the Monitor with an appropriate Patient Cable. Select LEAD II. Adjust the ECG SIZE until the R waves are detected.

4. FRONT PANEL CONTROL RESPONSES.

   Set the RATE control to 60 BPM and the CURRENT control to III.

   A. Depress the NON DEMAND push button and verify that the NON DEMAND LED and legend illuminates.

   B. Depress the START STOP push button and verify that the START STOP LED and TEST legend blink simultaneously at 60 BPM.

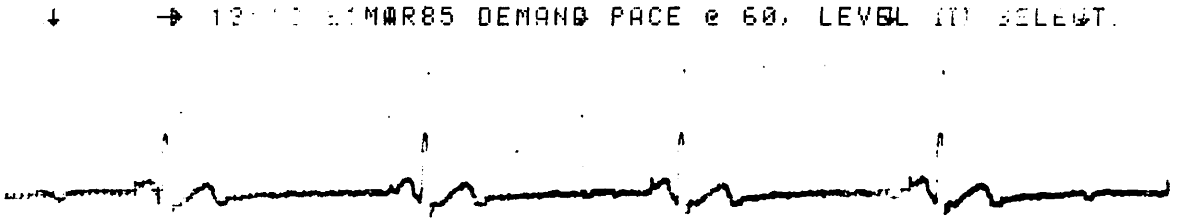
   C. Depress the START STOP push button and verify that pacing stops.

   D. Depress NON DEMAND and then depress DEMAND. Verify that the DEMAND LED is illuminated and that SYNC marks appear on the QRS portion of the ECG waves displayed on the Monitor CRT.

E. Depress START STOP and verify that the START STOP LED and the TEST legend flash simultaneously and pacing spikes appear on the Monitor CRT.

5. PACING CASSETTE OUTPUT TO MONITOR.

A. Depress the DELAY push button on the Monitor and verify that the Recorder prints a strip similar to the one shown below:



B. Depress DELAY again to stop the Recorder.

6. DEMAND INTERVAL TIMER.

A. Set the RATE switch to 40 BPM and verify that the TEST legend ceases to flash.

B Press START STOP followed by DEMAND and verify that pacing stops.

7. OUTPUT WAVEFORM.

Connect a Pacing Cable to the PACE output jack.

Connect a 50 ohm 1/4W resistor across the pacing leads. The resistor leads may be wrapped around 10-32 screws to which pacing leads are attached. Connect an oscilloscope across the resistor. Set the oscilloscope to 5ms/div, 2V/div, single sweep, store mode, and positive slope (refer to Section 3, Figures 3-1 and 3-10).

Set the RATE switch to 60 BPM and the CURRENT knob fully clockwise.

Depress DEMAND followed by START STOP to initiate DEMAND mode pacing.

Observe the trapezoidal waveform developed across the resistor. The waveform shall have a peak amplitude of 8.1-12V and a duration of 20 ±1ms.

8. NO ECG WARNING.

Disconnect the Monitor from the Defibrillator.

A. Depress the DEMAND push button. Verify that the NO ECG legend flashes three times along with three tones and the DEMAND LED is not illuminated. Repeat with the NON DEMAND push button and verify that the NO ECG legend again flashes three times with a tone each time and neither the NON DEMAND LED or legend illuminates.

Reconnect the Monitor and Defibrillator and initiate pacing. Set the Monitor LEAD SELECT to STD.

B. Verify that NO ECG flashes continuously with a continuous tone.

C. Set LEAD SELECT to Lead I. Verify that the tone stops and NO ECG is steadily on.

D. Depress the START STOP push button. Verify that NO ECG goes out and pacing starts.

9. LEAKAGE.

Check ac leakage in accordance with AAMI/ANSI 3.2.1.22.

A. Chassis Leakage: Less than 100μA.

B. Lead Source Current: Less than 10μA.

C. Lead Sink Current: Less than 20μA.

DATE ____________

FIGURE 2-10. LIFEPAK 8 PACING CASSETTE PERFORMANCE VERIFICATION CHECKLIST

1. PHYSICAL INSPECTION.. ______

2. POWER-ON.. ______

3. R WAVE DETECTION.. ______

4. FRONT PANEL CONTROL RESPONSES............................... ______

   A. NON DEMAND LED and Legend Illuminates...................... ______
   B. START STOP LED and TEST Blink Simultaneously................ ______
   C. Pacing Stops.. ______
   D. DEMAND LED Illuminated and Sync Marks Appeared.............. ______
   E. START STOP LED and TEST Legend Illuminates, Pacing Spikes... ______

5. PACING CASSETTE TO MONITOR

   A. Correct Strip is Produced by Recorder....................... ______
   B. DELAY Stops the Recorder.................................... ______

6. DEMAND INTERVAL TIMER

   A. TEST Legend Stops Flashing.................................. ______
   B. Pacing Stops.. ______

7. OUTPUT WAVEFORM

   Waveform Amplitude.. ____V
   Duration.. ___ms

8. NO ECG WARNING

   A. NO ECG Flashes, Three Tones Sound........................... ______
   B. NO ECG Flashes Continuously, Continuous Tone................ ______
   C. No Tone, NO ECG On.. ______
   D. NO ECG Off, Pacing Starts................................... ______

9. LEAKAGE

   A. Chassis Leakage (≤ 100μA).................................. ___μA
   B. Lead Source Current (≤ 10μA)............................... ___μA
   C. Lead Sink Current (≤ 20μA)................................. ___μA

2-10. OPERATOR MAINTENANCE

The following paragraphs contain routine maintenance procedures that can be performed either by an experienced operator or a technician.

2-11. Recorder Paper Replacement.

CAUTION

DO NOT RUN RECORDER WITHOUT PAPER. PRINTHEAD DAMAGE MAY RESULT.

A. Pull out paper carrier.

B. Remove old paper roll.

C. Replace with new paper roll. Note that the recorder paper must come off the roll in a counterclockwise direction.

D. Pull out short length of paper and close paper carrier.

E. Turn Monitor on. Select Lead position STD. Depress DIAG push button to turn Recorder on. While Recorder is running, push edge of paper under roller at left side of the Recorder. Paper will emerge after being pulled through roller. Stop Recorder by depressing DIAG key again.

2-12. Recorder Stylus Replacement and Adjustment.

NOTE: The special stylus tool (part of the replacement kit) will be required in the following procedure. For more detailed information, refer to instruction sheet accompanying replacement stylus.

A. Press Monitor ON push button to turn power off.

B. Remove Recorder from Monitor. See Section 4 for procedure.

C. Pull out paper carrier, then carefully slide the stylus from the black plastic mounting block.

D. Replace with new stylus. Seat firmly in mounting block, then close paper carrier.

E. Adjust stylus pressure screw (see Figure 2-11) so that stylus touches paper.

NOTE: The following adjustments may be performed with the Recorder installed in the Monitor, however, they are more easily accomplished if Recorder is reconnected to Monitor using the Type 1, 32 pin, Extender Cable listed in Table 3-1.

F. Replace Recorder in Monitor or use the Type 1 Extender Cable and press Monitor ON. Select STD lead position and place Recorder in diagnostic mode.

G. Adjust the stylus heat control as necessary. The potentiometer is located below the base of the stylus. See Figure 2-11. A light line will provide a longer stylus life.

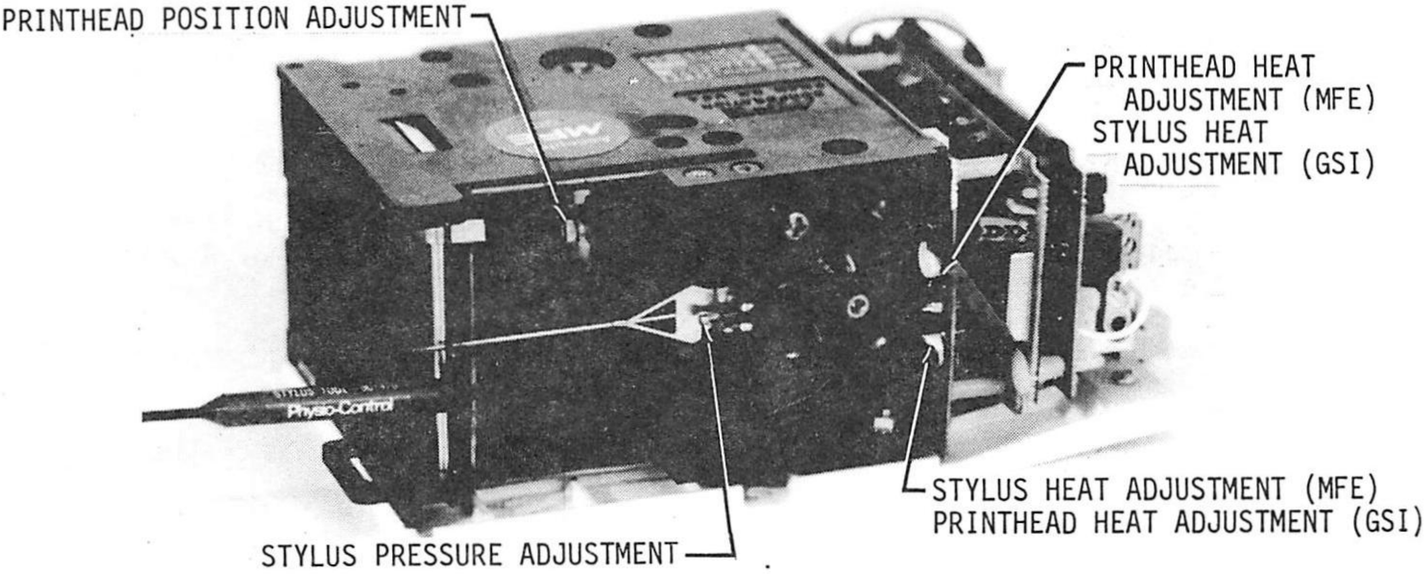

PRINTHEAD POSITION ADJUSTMENT
PRINTHEAD HEAT ADJUSTMENT (MFE)
STYLUS HEAT ADJUSTMENT (GSI)
STYLUS TOOL
Physio-Control
STYLUS HEAT ADJUSTMENT (MFE)
PRINTHEAD HEAT ADJUSTMENT (GSI)
STYLUS PRESSURE ADJUSTMENT

FIGURE 2-11. RECORDER ADJUSTMENTS

H. Set ECG SIZE to X1.0 and with the Recorder in diagnostic mode, repeatedly depress the CAL key. Observe the deflection and compare with Figure 2-12.

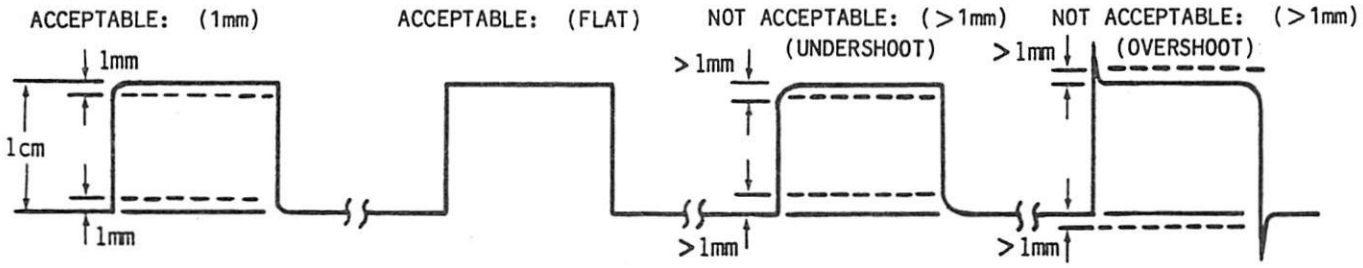

ACCEPTABLE: (1mm)
ACCEPTABLE: (FLAT)
NOT ACCEPTABLE: (>1mm)
(UNDERSHOOT)
NOT ACCEPTABLE: (>1mm)
(OVERSHOOT)
1mm
1cm
1mm
>1mm
>1mm
>1mm
>1mm

FIGURE 2-12. STYLUS DEFLECTION WAVEFORM

I. Adjust stylus pressure screw if necessary (Figure 2-11). Repeat step H, above.

NOTE: To insure AHA frequency response, adjust the stylus pressure to 4-6 grams using a gram gauge and check response to AHA specifications.

2-13. Recorder Printhead Replacement and Adjustment.

A. Press Monitor ON to switch power off.

B. Remove Recorder from Monitor. See Section 4 for procedure.

C. To replace printhead assembly, printhead flex must be disconnected from connector located on Recorder PFC.

NOTE: Be careful when removing or installing the printhead flex. It is fragile and will tear easily.

D. Remove two screws securing printhead mounting block to the Recorder.

E. Separate printhead with attached flex from the Recorder Assembly.

F. To install printhead, connect flex to Recorder PFC connector, then secure printhead mounting block to Recorder with two screws.

G. The hex head cap screw which secures the printhead to the mounting block is also used to position the printhead for optimum printing quality (refer to Figure 2-11). Position printhead so that it makes contact with recorder paper approximately 1/32" from tip of heating element.

NOTE: Small changes in printhead position can have a pronounced affect on print quality.

H. If printhead heat also requires adjustment, proceed as follows:

1. Switch Monitor off and place Monitor in Service Mode by setting Control PCB rocker switch #1 to the closed position (see Figure 5-12). The 8 bank DIP switch is accessible through a vent slot near the bottom of the Rear Case. Rocker switch #1 is at the end of the DIP switch closest to the front of the Monitor.

   When in Service Mode, pressing DIAG push button causes the recorder character set to be printed out. Printhead adjustments are therefore easily evaluated.

2. Set printhead heat to minimum by turning potentiometer fully clockwise (MFE) or counterclockwise (GSI) (refer to Figure 2-11).

3. Switch Monitor power ON.

4. Select 50mm/s and press DIAG key. Adjust printhead positioning screw to obtain the best print quality.

5. Adjust printhead heat for desired darkness. Characters should be clear with no dot smearing. Dot smearing indicates excessive heat which can decrease printhead life.

NOTE: Refer to paragraph 3-32D (Printhead Heat) for optimum method of printhead heat adjustment.

6. Switch Monitor power off.

7. Return rocker switch #1 to open position.

2-14. Battery Maintenance. The life expectancy of nickel-cadmium batteries is dependent upon many variables, but the primary factors are temperature and use.

Optimum battery performance will occur when the instrument is operated and charged at normal room temperatures. When instrument is charging, ambient temperatures greater than 40°C may adversely affect battery capacity.

Batteries will also perform best if they are used regularly and not overcharged. Overcharging can occur if the instrument is continuously operated from ac line power. To minimize this condition, allow the instrument to operate on battery power for 45 minutes once each week. Routine biomedical checks should provide for deep discharge.

CAUTION

DO NOT DRAIN THE INTERNAL BATTERIES COMPLETELY; TO DO SO MAY CAUSE DAMAGE. TURN POWER OFF WHEN NOT IN USE. CONNECT TO AC POWER WHEN LOW BATTERY LEGEND IS ILLUMINATED.

2-15. External Cleaning.

The LIFEPAK 8 case, paddles, cables, test load contacts, recorder platen, and cardioscope screen should be cleaned with mild soap and water. Use a damp sponge or towel to clean. Do not immerse any portion of the LIFEPAK 8 Defibrillator/Monitor in water. Do not use alcohol or ketones (MEK, acetone, etc.).

2-16. Preparation for Storage or Shipment.

It is recommended that the original shipping box and packing for the LIFEPAK 8 be saved for later use in storage or shipment (see Figure 2-13).

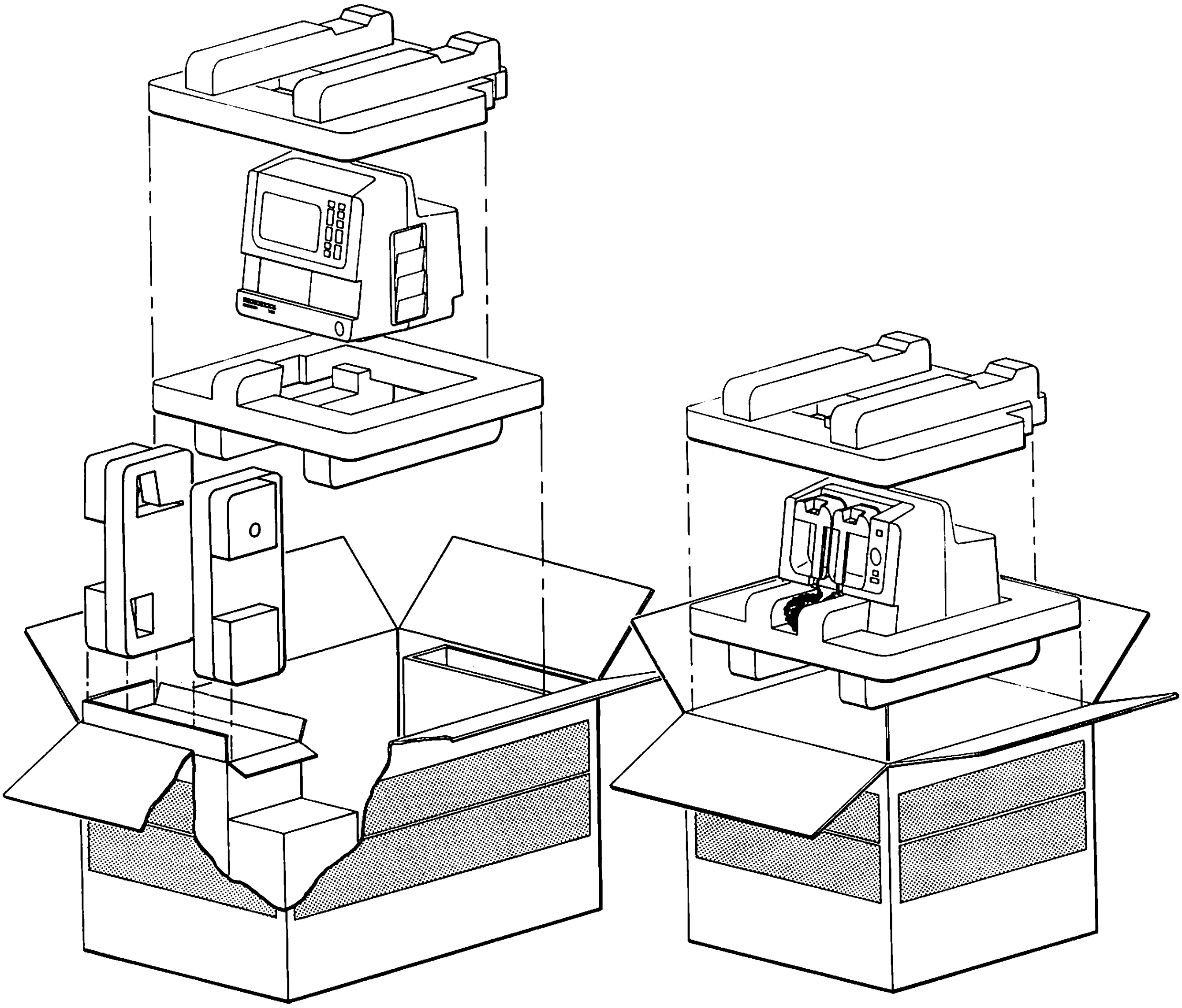


FIGURE 2-13. PREPARATION FOR STORAGE OR SHIPMENT

SECTION 3
TESTING AND TROUBLESHOOTING

3-1. OVERVIEW

This section will guide the user in a sequential fashion from routine, system-level test and calibration procedures to the identification of faulty circuits in the LIFEPAK 8. Included are Test Equipment List and Test and Calibration procedures for the ECG Monitor (paragraphs 3-4 through 3-36), the DC Defibrillator (paragraphs 3-37 through 3-50) and the Pacing Cassette (paragraphs 3-51 through 3-54).

NOTE: When testing, troubleshooting, or repairing an instrument, observe the Servicing Techniques listed in Section 4.

CAUTION

SOME PCB ASSEMBLIES IN LIFEPAK 8 CONTAIN STATIC SENSITIVE DEVICES ⚠ (SSDs). REFER TO SECTION 5 AND USE SPECIAL HANDLING PROCEDURES.

3-2. SERVICING TECHNIQUES

The following techniques should be used when general service, repair or troubleshooting is performed on the LIFEPAK 8. For more detailed service and repair information refer to Section 4.

A. Before removing a PCB for repair or replacement, label each lead or draw a sketch showing the location of cables and wires.

B. Use a soldering pencil with a rating of 25W. A soldering gun is usually too hot and cumbersome, which easily leads to damaged components and/or PCBs.

C. Use only 60/40 solder of low melting temperature. If needed, a non-corrosive flux can be used to aid in soldering flow. The PCB should be thoroughly cleaned afterwards.

D. A heat sink or similar device should be used in soldering semiconductor components. This also helps prevent damaging the solid state devices.

E. Breaks in PCB lands should be repaired by bridging with wire from pad to pad, not by laying solder across the break. The heat from the soldering iron may cause the land to dislodge from the board.

F. For cleaning external covers, patient cable, and the CRT face, use a mild detergent-type cleaner (e.g., dishwashing liquid). Do not use alcohol, solvents, cleaning solutions or agents with ammonia. These agents may damage the surfaces of the instrument. For interior cleaning, use dry compressed air. A dry flexible paint brush can be used to dislodge dust.

3-3. TEST EQUIPMENT

Test instruments suitable for maintenance and calibration of the LIFEPAK 8 System are listed in Table 3-1. Although specific, commercially available test instruments are recommended, OTHER TEST EQUIPMENT WITH SPECIFICATIONS EQUIVALENT TO THOSE LISTED MAY BE USED.

TABLE 3-1

TEST EQUIPMENT

NOMENCLATURE	CHARACTERISTICS	MANUFACTURER
DC Power Supply	Output Voltage: 0-20Vdc Output Current: 0-10A	Deltron Model SP20-10, or equivalent.
Storage Oscilloscope	Bandwidth: dc, to 100MHz Vertical Sensitivity: 5mV/div to 50V/div Input Impedance: 10 MΩ Sweep Range: 1μs/div to 1s/div	Tektronix Model 465 with camera, or equivalent.
Digital Multimeter (DMM or DVM)	Range: 0 to 1000VFS Accuracy: 0.5% of full scale on dcV and resistance ranges, 1% of reading on acV.	Fluke 8000A with high voltage probe or equivalent.
Energy Meter	Power Range: 0-1000J Load resistance: 50 Ω ±0.5% Accuracy: ±2% of full scale for pulse width of 5ms.	Electronics Unlimited DT 650.
Stopwatch	Accuracy: ±0.25 second	
Variable Autotransformer	0-140V RMS 0-240V RMS Current rating: 5A	General Radio W8MT3 (120V) Superior Electric, Type 3PN226 (230V) or equivalent.
Function Generator	Frequency Range: 20-120 PPM Pulse Required: Positive 0-5V 10ms	Krohn-Hite Model 5400A or equivalent.
Isolation Transformer	250VA, 60Hz	Stancor G1S-250
ECG Simulator		SVC-T-500

TABLE 3-1 (Continued)

TEST EQUIPMENT

NOMENCLATURE	CHARACTERISTICS	MANUFACTURER
PCB Assembly, Extenders	Type 1, 32 Pin Type 2, 64 Pin Type 3, 48 Pin Type 4, 18 Pin Type 5, 30 Pin	PCC No. 803367 PCC No. 803519 PCC No. 803522 PCC No. 803514 PCC No. 803525
Gram Gauge	Range: 2-20g (Flat Tip)	Halda Dynamometer Type Gram Gauge or equivalent.
Counter/Timer		Tektronix Model DC 504 or equivalent.
Stylus Adjustment Tool		PCC No. 801470-00
Flex Removal Tool		PCC No. 800742-03
LP 8 Pacing Cassette Load	See Figure 3-1	

NOTE: Equipment configuration may vary from that described in this manual.

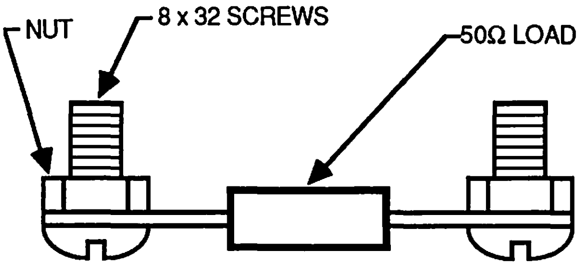


FIGURE 3-1. LP 8 PACING CASSETTE LOAD

3-4. MONITOR FUNCTIONAL TEST AND CALIBRATION

Procedures provided here may be used to verify that the LIFEPAK 8 Monitor is operating within specifications. If the instrument is not functioning properly, locate and repair the malfunction before attempting final instrument calibration or adjustment.

3-5. Initial Setup.

A. Unit should be assembled with PCBs installed, but with rear case removed and the Rear Panel PCB connected to the Main PFC with a Type 4 PCB Assembly Extender (see Table 3-1). Remove J3 on Charger PCB (see Figure 5-9) to disconnect battery and disconnect the ac power cord from the line power source.

B. Connect the Monitor Patient Cable to the ECG simulator.

NOTE: Support back of ECG PCB when installing patient cable connector.

C. Insert a Type 1 PCB Extender (see Table 3-1) into Main Flex connector J6 (the accessory connector) to allow easy measurement of supply voltages. (Voltages are measured in paragraph 3-9, A.)

D. Set Rear Panel CRT bright control (R1) to midrange (refer to Figure 2-2 for location of controls). Turn the volume control (R2) fully counterclockwise (CCW).

E. The ECG PCB (Figure 5-11) and Control PCB (Figure 5-12) have DIP switches to program Monitor operating modes. Tables 3-2 and 3-3 indicate switch settings for standard operation of each Final Assembly unit configuration listed in Figure 5-1.

Following each table is a list of switch functions. These switches allow the user to change indicated operating characteristics from the standard factory settings if desired.

The tests in this section should be performed with the Monitor DIP switches as set by the factory unless otherwise stated.

NOTE: The DIP switches on the Gateway PCB are used only for factory tests and should be set in the open position for normal operation. Verify that all switches are in the open position.

F. When the output from a function generator is required, use the test setup shown in Figure 3-2, Standard Test Signal Input, then select Monitor lead position II.

G. Install recorder paper in the Recorder. Refer to paragraph 2-11.

NOTE: The position of rocker switch #1 on the ECG PCB DIP switch is toward the back of the Monitor as marked on the circuit side of the PCB.

TABLE 3-2

ECG PCB PROGRAMMING
SWITCH SETTINGS
(0 = OPEN, 1 = CLOSED)

	SWITCH NUMBER			
UNIT CONFIG.	1	2	3	4
802800-14	0	0	0	0
802800-15	1	0	0	0
802800-16	0	0	0	0
802800-17	1	0	0	0
802800-18	1	0	0	0
802800-19	0	0	0	0
802800-20	0	0	0	0
802800-21	1	0	0	0
802800-22	0	0	0	0
802800-23	1	0	0	0
802800-24	0	0	0	0
802800-25	0	0	0	0
802800-26	0	0	0	0

SWITCH NUMBER	FUNCTION OPEN	CLOSED
1	60Hz filter	50Hz filter
2	Standard	Factory use only
3	Heart rate display blanked in pacing mode.	Heart rate displayed in pacing mode.
4	Sync mark activated by Defibrillator.	Sync mark always on.

TABLE 3-3

CONTROL PCB PROGRAMMING
SWITCH SETTINGS
(0 = OPEN, 1 = CLOSED)

UNIT CONFIG.	SWITCH NUMBER 1	2	3	4	5	6	7	8
802800-14	0	1	0	0	0	0	0	1
802800-15	0	1	0	0	0	0	0	1
802800-16	0	1	0	0	0	1	0	1
802800-17	0	1	0	0	0	1	1	0
802800-18	0	1	0	0	1	0	0	1
802800-19	0	1	0	0	1	1	0	1
802800-20	0	1	0	0	1	1	0	1
802800-21	0	1	0	0	0	0	0	1
802800-22	0	1	0	0	0	0	0	1
802800-23	0	1	0	0	0	0	0	1

SWITCH NUMBER	FUNCTION OPEN	CLOSED
1	Standard	Service Mode
2	No Recorder test at power up.	Recorder power up test enabled.
3	No alarms during pacing.	Alarms active during pacing.
4	PADDLES selected at power up if Defibrillator is on.	Lead II always selected at power up.
5 & 6	Language Selection for CRT and Recorder.	
7	Domestic low frequency response (-3dB)	International low frequency response (-3dB at .24-.3Hz)
8	International Aspect ratio 1:1	Domestic Aspect ratio 1:1.7

3-6. Current Tests.

A. Disconnect J3, pin 3 (red wire), on the Charger PCB and place an ammeter in series with pin 3 and the disconnected wire. Verify that battery current drain is less than 13mA.

B. Connect line power. Verify battery current sink is 123mA minimum, 151mA maximum.

3-7. Front Panel Tests.

A. Remove ammeter and reconnect J3 on Charger PCB.

B. Depress MAINS POWER (Rear Panel) and verify that front panel BATTERY and CHRG legends are illuminated.

NOTE: The position of rocker switch #1 on the Control PCB DIP switch is toward the front of the Monitor.

C. Press the ON push button (Front Panel) and verify that all push-buttons with LEDs and the SERVICE legend illuminate for 2 seconds. Verify that the ON push button LED remains illuminated, and the SERVICE legend turns off.

NOTE: The SERVICE legend indicates an instrument malfunction that requires attention. It will remain on if the Monitor fails any of the following Power-On Self-Tests.

- LED Test - verifies that all LEDs remain on for 2 seconds.
- Preamp Calibration Test - verifies correct transmission of an injected signal across preamp isolation circuitry.
- Recorder Test - Recorder runs, annotates an event marker and displays one CAL pulse. This test can be disabled by opening Control PCB rocker switch #2.
- Serial Data Loop Test - verifies correct transmission of data through serial loop.
- A/D Converter Test - verifies accurate conversion of an input voltage using a CAL pulse.
- Heart Rate Alarm Test - detects an out of limit rate.

3-8. CRT Display and Recorder Annotation Tests.

A. Verify that within 10 seconds of power-on "---" appears in heart rate display with Lead II and X1.0 displayed beneath. Adjust Rear Panel CRT BRIGHT control (R1) as required to view both alphanumerics and trace.

B. Verify that during power-on the Recorder runs briefly, annotating " → XX:XX XXMONXX DIAG X1.0" (run time = approximately 3 seconds).

NOTE: Time/Date may be either the correct time ±1 minute
or 01:00 1JAN84.

C. Verify that the recorder trace is legible, centered ± 2mm, and appears within 1 second of start of paper feed.

3-9. Power Supply Tests.

A. Verify the following voltages at J6 (Main PFC see Figure 5-20):

+15V Supply = +15.0 ±.6Vdc at pin 2A
+5V Supply = +5.0 ±.25Vdc at pin 16A
-15V Supply = -16.2 ±1.6Vdc at pin 3A

B. Verify that the Grid 2 voltage is +360 to +400V at J2 (see Figure 5-15) on the Anode Supply PCB.

3-10. Real Time Clock Set.

Press the Rear Panel CLOCK/DATE MODE push button to select each clock mode (hour, minute, year, month, day). The selected mode will appear on CRT in lower left corner. Press SET push button to set each function to current date and time. When all clock functions have been set, press CLOCK/DATE MODE one more time to blank the display. Note that time is presented in military standard (2:00 PM = 14:00 hours).

3-11. LEAD SELECT Logic.

Press the LEAD SELECT push button and verify that the lead selected designator on the CRT toggles through III, AVR, AVL, AVF, V, STD, I and then back to II, but does not select PADDLES.

3-12. Recorder Speed/CRT Time Base.

After completing Initial Setup (paragraph 3-5) and Real Time Clock Set (paragraph 3-10), proceed as follows to accomplish Recorder speed and CRT display calibrations (refer to paragraph 3-27 for detailed Recorder calibration procedures).

A. Select 60 BPM on the ECG simulator. On the Monitor select Lead II and ECG SIZE X1.0. Activate Recorder in DIAG mode.

NOTE: If Recorder PFC adjustment is required, remove Recorder (see Disassembly Procedure in Section 4) and reconnect to Main PFC with a Type 1 (32 pin) PCB Extender. See Figure 3-7 for PFC potentiometer locations.

B. Verify that the QRS peaks are 25 ± 1mm apart on the Recorder. Adjust R18 (MFE) or R24 (GSI) on Recorder PFC, if needed.

C. Select 120 BPM. Pause 5 seconds, freeze the display, and verify that all peaks are separated by 12.5 ± 1.0mm across entire screen. Adjust R3 on CRT PCB, if necessary (see Figure 3-5).

D. Depress the 50mm/s push button. Verify that its LED is illuminated.

E. Verify that the QRS peaks are 25 ± 1mm apart on the Recorder. Adjust R18 (MFE) or R23 (GSI) on Recorder PFC, if necessary.

F. Verify that the QRS peaks are 25 ± 1.0mm apart at the CRT. Adjust R3 on CRT PCB, if needed.

G. Press 50mm/s push button to return to 25mm speed mode.

3-13. ECG Display.

Select LEAD II. Decrease the gain to X0.2. Adjust the ECG simulator to 60 BPM. Verify that "---" is present in heart rate display. Also verify that ECG signal displayed on both CRT and Recorder is positive in polarity.

3-14. Heart Rate.

A. Increase ECG amplitude in steps by pressing ECG SIZE ▲ push button.

B. Set ECG size to 1.0. Verify that the red systole indicator (above the CRT) flashes with each ECG R wave.

C. Verify the heart rate display settles to 60 ± 2BPM.

D. Select AVR. Verify the same rate display for an inverted input. Reselect Lead II and set ECG size to X2.0.

3-15. Systole Beeper.

A. Depress and hold the QRS VOLUME ▲ push button for 2 seconds. Verify the presence of a high pitched beep at 60 BPM.

B. Hold the QRS VOLUME ▼ for 2 seconds. Verify that beep becomes inaudible.

3-16. Alarm Function/Heart Rate Step Response/Auto Record Function.

A. Depress the the HIGH ALARM ▲ push button until the upper alarm limit indicates 100. Similarly, set the LOW ALARM ▼ to 40.

B. Depress the Recorder ALARM push button and verify that its LED illuminates.

C. Increase simulated BPM to 120. Verify that within 5 seconds a dual tone alarm sounds, the Recorder starts (and then runs for 20 ± 1 seconds), and the heart rate display settles to 120 ± 4 BPM.

D. Verify that the alarm volume is adjustable as indicated on the Rear Panel control.

E. Verify that the ALARM SILENCE push button operates (silences alarm for 64 ± 4 seconds), then set ECG simulator to 60 BPM and verify that alarm stops. Verify also that the displayed heart rate is 60 ± 2 BPM.

F. During annotations, check time and date for accuracy.

G. Verify that the recorder Paper is annotated as follows:

At start: " → XX:XX XXMONXX PRE-ALARM"

NOTE: MON = MONTH

At 10 seconds: "▼ALARM XX:XX XXMONXX Lead II X1.0 HR=XXX." The "X1.0" annotation depends on ECG SIZE setting.

H. Set simulated BPM to 30. Verify that the alarm sounds again, and that Recorder activates automatically within 5 seconds of the rate change.

I. Verify the ALARM LED extinguishes and Recorder stops immediately if the ALARM push button is pressed during the auto-writeout period.

J. Verify that alarm limits may be cleared by depressing the LOW ALARM OFF and HIGH ALARM OFF push buttons.

3-17. EVENT Function.

A. Depress the EVENT push button and verify that the Recorder runs for 20 ± 1 seconds and that all annotation clears the recorder paper tear bar.

B. Verify that both the EVENT and DELAY LEDs illuminate while the Recorder runs.

C. Verify that the recorder paper is annotated as follows:
At Start-up: " → XX:XX XXMONXX PRE-EVENT"
At 10 ± 1 seconds following Recorder start-up: " ↓ EVENT XX:XX XXMONXX LEAD II X1.0 HR=30".

3-18. FREEZE Function.

Verify that the CRT display freezes while the FREEZE push button is depressed.

3-19. DELAY Function.

A. Select Lead STD. Set ECG size to X1.0. Depress the DELAY push button.

B. Verify that the Recorder starts and that the DELAY LED is on.

C. Depress the CAL push button. Verify that 10 ± 1 seconds later a 1cm ± 0.5mm pulse appears on the Recorder strip chart.

D. Select Lead II. Verify that 10 ± 1 seconds later the Recorder annotates as follows:

" ➔ XX:XX XXMONXX LEAD II X1.0 HR=XX"

E. Verify Recorder display is of same polarity as the CRT.

3-20. Delay and Diagnostic Recorder/CRT Frequency Response.

A. Connect function generator to patient cable between white and red leads.

B. Adjust function generator for 10Hz, 1mV p-p sine wave. Refer to Figure 3-2, Standard Test Signal Input. Adjust ECG SIZE to X1.0. Verify 10 ± .5mm p-p on Recorder in DIAG mode. Adjust R5 (MFE) or R1 (GSI) on Recorder PFC if necessary.

C. Switch the Recorder to DELAY mode. Adjust R51 on the Control PCB (refer to Figure 5-12) if necessary to obtain a 10 ± .5mm p-p sine wave on the Recorder.

D. Adjust R68 on the Control PCB for 1.7 ± .1cm p-p on the CRT.

E. (For 802800-17 Monitors (240V French) set DIP rocker switch #8 on the Control PCB to 0 (open) and verify 1.0 ± .1cm on CRT.)

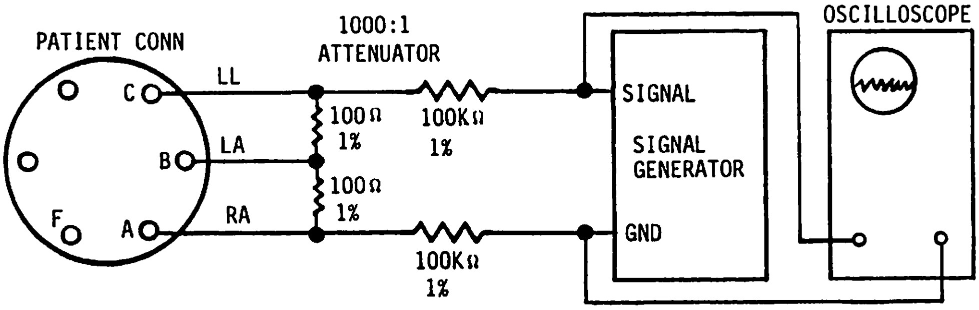


FIGURE 3-2. STANDARD TEST SIGNAL INPUT

F. Verify that Recorder trace is no less than 7mm p-p in DELAY record at 1Hz. (For 802800-17 Monitors (240V French), set DIP rocker switch #7 on the Control PCB to 1 (closed) and verify the Recorder trace is not less than 7mm p-p in DELAY record at 0.3Hz.)

G. Sweep the function generator from 1.0-30Hz. Verify that response is between 7mm minimum and 11mm maximum. (For 802800-17 Monitors (240V French), sweep function generator from 0.3Hz to 30Hz. Verify the response is between 7mm minimum and 11mm maximum.)

H. Set function generator to 10Hz and ECG SIZE to X2.0 in DELAY record. Verify that Recorder trace amplitude is at least 14mm but not greater than 22mm between 1Hz and 30Hz. Depress DELAY push button to turn Recorder off.

I. Set function generator to 10Hz and ECG SIZE to X1.0. Adjust output to obtain 10mm p-p signal on CRT. Set frequency at 1Hz. Verify that CRT trace is at least 7mm p-p.

J. Sweep function generator from 1Hz to 30Hz. Verify that CRT response is between 7mm minimum and 11mm maximum.

K. Set function generator to 10Hz and ECG SIZE to X2.0. Sweep frequency from 1Hz to 30Hz. Verify that response is between 14mm minimum and 22mm maximum on CRT.

3-21. Diagnostic Recorder Frequency Response.

A. Select DELAY (switch LED should be on). Select DIAG. Verify that the DIAG LED illuminates and the DELAY LED turns off.

B. Adjust the function generator to 10Hz, 1mV p-p sine wave. Set ECG SIZE to X1.0.

C. Verify that the recording is at least 7mm p-p but not more than 11mm p-p between .05Hz and 100Hz.

D. Select an ECG SIZE of X1.0. Select STD. Depress CAL push button. Verify that the CAL pulse is 10 ± 0.5mm above baseline on Recorder. Overshoot must be less than 0.5mm.

E. Press DIAG push button again and verify that Recorder stops and DIAG LED turns off.

3-22. CAL Pulse Function.

With LEAD SELECT in STD and ECG SIZE at X1.0 depress the CAL push button. Verify that a 1.7 ± 0.1cm pulse occurs on the CRT and that a 1.0 ± .075V p-p pulse occurs at J2, pin 5, on rear panel SYSTEMS connector.

3-23. Gain Adjust.

A. Depress and hold the ECG SIZE ▲ and verify that the CRT size indicator (below lead indicator) increments. Stop at X2.0.

B. Depress the CAL push button. Verify that the pulse height on the CRT is now 3.4 ± 0.2cm high.

C. Verify that Recorder in DIAG mode displays a 2cm ± 1mm pulse.

D. Increase the gain to X4.0. Verify that pressing the CAL push button results in an off-scale pulse on CRT.

3-24. Recorder Status Message Annotation.

Set ECG SIZE to X2.0. Connect the patient cable leads to the ECG simulator and set the QRS rate to 120 BPM. Verify that once each 20 ± 1 seconds the Recorder annotates in DIAG mode at 50mm/s as follows:

"HH:MM DDMONYY LEAD II DIAG X2.0 HR=XXX 50mm/s"
(XXX = 120 ± 4BPM)

3-25. X1 ECG Output.

Set ECG SIZE to X1.0. Reconnect the function generator to the patient cable between the red and white leads. Select a 10Hz sinewave at 1V p-p. Verify a 1 ±.1V p-p signal at J2, pin 5, the X1 ECG OUTPUT, of the Rear Panel SYSTEM connector.

3-26. Preamp Common Mode Rejection.

A. Set ECG size to X4.0.

B. Set the function generator for 5V p-p at line frequency (50 or 60Hz). Connect one side of function generator to iso-ground (anode of CR4). Short the White, Black, Red and Brown leads of patient cable together and connect them to the other side of the function generator.

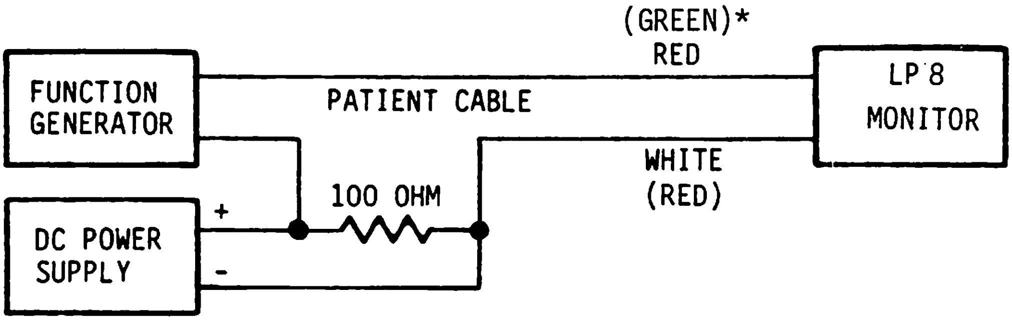
C. Verify that at J2, pin 5, the X1 ECG output, the signal is 600mV p-p or less in each lead position.

D. Disconnect the function generator from the leads.

E. Depress the power ON push button to turn off LP 8 Monitor.

3-27. Preamp Offset Recovery.

A. Adjust the function generator to produce a 1V p-p, 10Hz sinewave. Connect the function generator to a dc power supply and patient cable as shown in Figure 3-3, then turn off function generator.



*Lead wire colors in parentheses are for IEC cables; nonparentheses colors refer to AHA cables.

FIGURE 3-3. OFFSET CHECK SETUP

B. Adjust the dc power supply to produce +0.6Vdc and turn power supply off.

C. Turn on LP8 Monitor. Set ECG SIZE to X1.0 LEAD SELECT to II and depress DIAG push button.

D. Turn on the dc power supply and verify that the Recorder recovers to within 10mm of its previous baseline position within 3 seconds of the offset.

E. Repeat above procedure for a -0.6V offset. Recovery should again be within 10mm of previous baseline within 3 seconds. Turn off power supply.

F. Turn on function generator (1mV p-p at 10Hz).

G. Select DELAY mode and adjust ECG SIZE to X1.0 on the CRT.

H. Turn on power supply (output still at -0.6V) and verify that Recorder baseline with signal restores within 3 seconds of offset.

I. Repeat above procedure for +0.6V offset.

J. Turn off power supply and function generator.

3-28. CRT Trace Quality.

This paragraph provides a check of display parameters. Paragraph 3-30 provides detailed calibration procedures.

A. Set ECG simulator to 120 BPM. Select Lead II. Set ECG SIZE to maximum and depress the CAL push button until the CRT display is filled with CAL pulses. Turn Recorder on in diagnostic or delay mode and verify that display is stable, not jittery and SERVICE does not illuminate.

B. Repeat previous step but with ac power disconnected. Verify that display is stable and that BATTERY legend is illuminated.

C. Verify with DMM that the voltage measured at J2, pin 3, of the CRT PCB is less than ±50mV with STD lead selected.

D. Verify trace is level ±1mm (in STD lead) with respect to top of bezel and vertically centered ±5mm.

E. Should adjustment be required, first verify that the yoke is firmly seated against the CRT tube. Rotate the beam centering rings located on the rear of the yoke to bring the beam position within the specified range. Adjustment of the beam centering rings may require readjustment of the character positioning electronics (see paragraph 3-30).

F. Select the service mode by setting rocker switch #1 on the Control PCB to closed position. Depress the CAL push button and verify that all alphanumeric fields fill with inverse video blanks.

G. Refer to Figure 3-6 and verify that the area occupied by the alphanumeric display field is 69.85 +0, -2.5mm in height and 21.3 ± 1.3mm in width. The leftmost edge of this field should be located 41.9 ± 1.3mm left of the vertical centerline of the CRT active viewing area (measured directly on the faceplate of the CRT). There should be no loss of characters displayed in the top or bottom fields.

H. Verify that trace is centered (STD lead) vertically with respect to the CRT's phosphor perimeter ± 0.5cm.

I. Remove unit from service mode by returning DIP switch #1 on the Control PCB to open position.

J. If necessary, adjust brightness by turning R1 (CRT BRIGHT) on the Rear Panel.

K. Refer to Figure 3-5 for location of adjustment potentiometers on the CRT PCB. Verify that the rising and falling edges of the waveform are equal in intensity to the baseline. Adjust R36 on CRT PCB, if necessary.

3-29. Anode Supply Adjustments.

This paragraph provides instructions on the calibration of the Anode Supply PCB. Refer to Figure 3-4 for the drain pulse width measurement, and to Figure 5-15 for the location of the adjustment potentiometers.

A. Adjust character brightness, R31, QRS intensity, R36 and Trace intensity, R40 on the CRT PCB, to minimum (refer to Figure 3-5, CRT PCB Adjustment Locations for locations of these potentiometers).

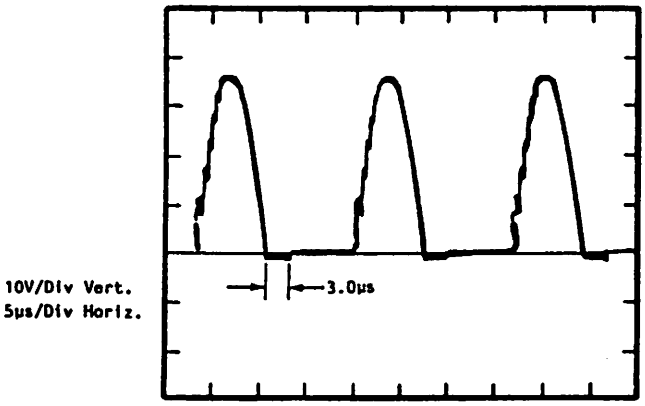


FIGURE 3-4. DRAIN PULSE WIDTH

B. Attach a scope probe to the drain of Q2.

C. Press the Monitor power ON push button and adjust R13 for a drain pulse width of 2.5 to 3.5 as shown in Figure 3-4.

D. Attach a high voltage probe to the CRT anode and adjust R6 for 9.5kV. Recheck the drain pulse width in step C.

NOTE: Due to the interaction of R6 and R13, it may be necessary to repeat steps C and D several times to obtain the proper operation parameters.

3-30. CRT Calibration.

This paragraph provides instruction on calibration of the CRT trace and raster adjustments. Refer to Figures 3-5 and 3-6 for adjustment potentiometer locations and trace position measurements.

A. CRT Brightness.

1. Press Monitor power ON push button. Select STD lead position. Turn CRT BRIGHT Rear Panel to minimum.
2. Turn QRS intensity R36 to minimum.
3. Adjust trace intensity R40 for adequate baseline brightness in a brightly lighted room.
4. Select Lead II and input a simulated 60 BPM ECG. Adjust ECG SIZE for a 25mm QRS deflection on the CRT.
5. Adjust QRS intensity R36 so that R waves and baseline are of equal intensity. Verify sync blip is clearly distinguishable.
6. Adjust raster brightness R31 so that alphanumeric display is approximately equal to the trace in intensity.

Raster
R13 Character horizontal position
R5 Character width
R52 Character vertical position
R46 Character height
R31 Brightness

Trace
R68 Vertical gain
R14 Horizontal position
R3 Horizontal width
R40 Trace intensity
R31 Brightness

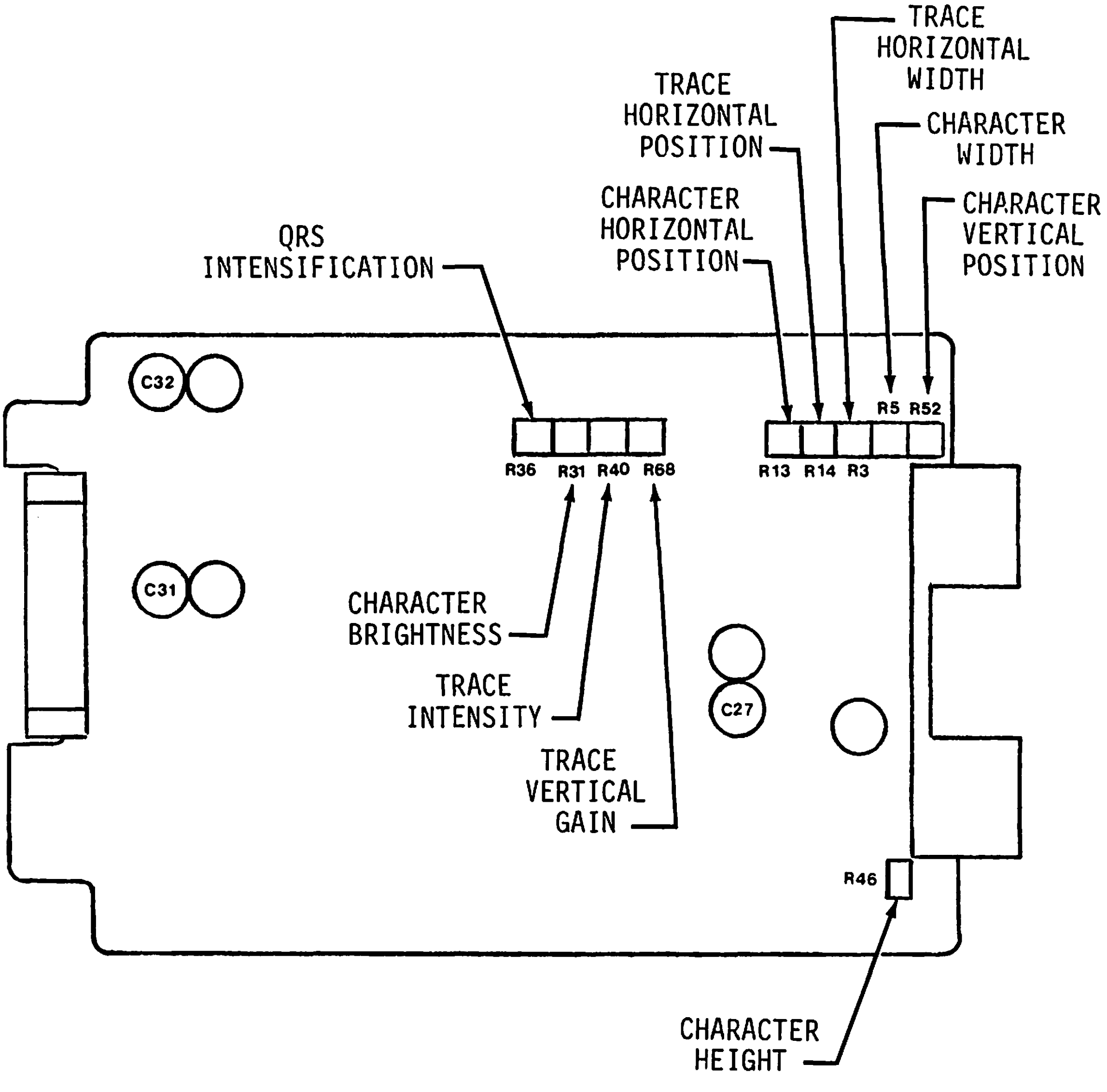

TRACE HORIZONTAL WIDTH
TRACE HORIZONTAL POSITION
CHARACTER WIDTH
CHARACTER HORIZONTAL POSITION
CHARACTER VERTICAL POSITION
QRS INTENSIFICATION
C32
R36
R31
R40
R68
R13
R14
R3
R5
R52
C31
CHARACTER BRIGHTNESS
TRACE INTENSITY
TRACE VERTICAL GAIN
C27
R46
CHARACTER HEIGHT

FIGURE 3-5. CRT PCB ADJUSTMENT LOCATIONS

B. Yoke Adjustments.

1. Press Monitor power ON push button and select STD lead position. If the trace is not parallel to the bottom of the Front Bezel, loosen yoke clamp and rotate yoke. Retighten clamp. (Refer to CRT Removal procedure in Section 4.)

2. Adjust the two yoke rings (see Figure 5-5) so that the trace is flat (± 1mm from end to end) and vertically centered (6.0 ± .5cm above bottom edge of black plastic Upper Front Panel).

C. Trace Adjustment. Before attempting ECG trace adjustments, vertical gain must be checked and calibrated for the Recorder and the SYSTEMS connector.

To do this, proceed as follows:

1. Input a 1mV p-p, 10Hz sine wave to Monitor through patient connector. See Figure 3-1.

2. Verify a 1V p-p ±.1V p-p output at rear panel SYSTEMS connector (J2, pin 5).

3. Place the Recorder in diagnostic mode and verify appearance of a 10 ± 1.0mm p-p sine wave on Recorder. If necessary, adjust R5 (MFE) or R1 (GSI) on the Recorder PFC (refer to Figure 3-7 for location of R5).

4. Now verify that in delay mode the Recorder still displays a 10 ± 1.0mm p-p sine wave. If necessary, adjust R51 on Control PCB (Figure 5-12) to equalize any difference in gain between diagnostic and delay mode.

5. After performing the above calibrations, adjust trace vertical gain R68 on CRT PCB, for a 17 ± 1mm p-p sine wave on CRT.

6. Input a 60 BPM ECG in Lead II and set ECG gain to X2.0.

7. (All potentiometers referred to, from this point to the end of 3-30.D, are located on the CRT PCB.) Freeze the trace and adjust trace horizontal width R3 so that the R wave peaks are 25 ± 1.0mm apart.

8. Adjust trace horizontal position R14 so that the ECG trace starts about 1/8" off screen. Since R3 and R14 interact, check their settings again and readjust potentiometers if necessary.

D. Raster Adjustment.

1. Select the Service Mode as in paragraph 3-28F.

   Press CAL to fill the raster's alphanumeric field. The entire field, rather than individual characters, will now be adjusted for size and position.

2. Refer to Figure 3-5 and 3-6 and adjust character horizontal position R13 until left edge of raster is 41.9 ± 1.3mm from center of CRT.

3. Adjust character width R5 until raster field is 21.3 ± 1.3mm wide.

NOTE: Since R5 and R13 interact, recheck horizontal position and readjust as necessary.

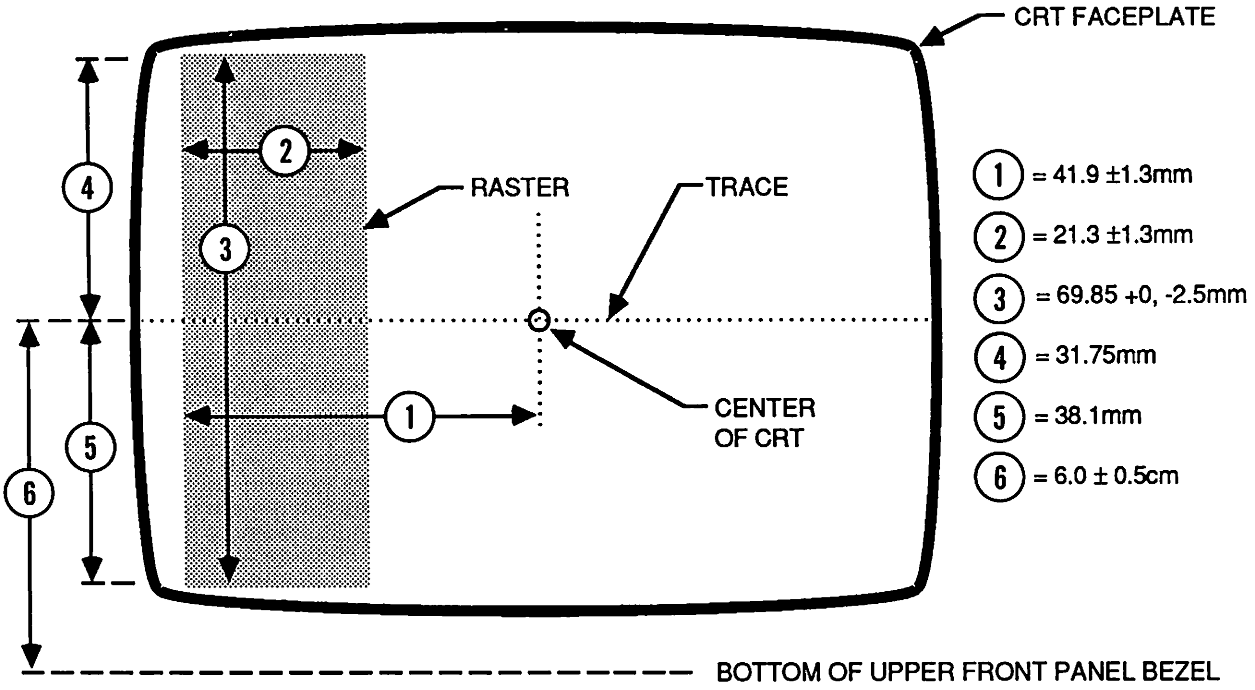

CRT FACEPLATE
RASTER
TRACE
CENTER OF CRT
BOTTOM OF UPPER FRONT PANEL BEZEL
① = 41.9 ±1.3mm
② = 21.3 ±1.3mm
③ = 69.85 +0, -2.5mm
④ = 31.75mm
⑤ = 38.1mm
⑥ = 6.0 ± 0.5cm

FIGURE 3-6. RASTER AND TRACE POSITION

4. Adjust character height, R46, until field is 69.85 ± 2.5mm in overall height.

5. Adjust character vertical position R52 until field is 31.75mm above and 38.1 below horizontal centerline.

6. Return Monitor to normal operating mode.

3-31. Noise.

A. Short all patient cable leads together.

B. Select ECG SIZE X4.0 and DIAG Mode.

C. Verify that Recorder noise is less than 2.0mm p-p in all leads, except Paddles and Lead V. In Lead V, verify that Recorder noise is less than 3.0mm p-p

D. Verify that CRT noise is less than 3.4mm p-p in all leads, except Paddles and Lead V. Verify that CRT noise is less than 5.1mm p-p in Lead V.

3-32. Recorder Calibration.

Use the Standard Test Signal Input, Figure 3-2, for the following Recorder tests. Note that voltages listed are function generator outputs. The Figure 3-1 circuit divides signal amplitude by 1000 before applying it to the Monitor. Refer to Figure 3-7 for potentiometer locations. Remove Recorder Assembly from instrument and connect to a Type 1 extender. (Refer to the disassembly procedure in Section 4.)

A. PAPER MOTOR SPEED.

1. Select Lead II and input a 1Hz, 1V p-p square wave to Standard Test Signal circuit.

2. Press DIAG push button and verify that leading edges of square waves are 25 ± 1mm apart at 25mm/s paper speed. Adjust R18 (MFE) or R24 (GSI) if necessary.

3. Press 50mm/s push button; verify that the leading edges are now 50 ± 2mm apart. Readjust R18 (MFE) or R23 (GSI) if necessary and repeat step 2.

B. STYLUS HEAT AND PRESSURE.

1. Set stylus pressure to 5-7 grams using a Gram Gauge.

2. Select Lead II and input a 10Hz, 20mm p-p sine wave. Select 25mm/s paper speed.

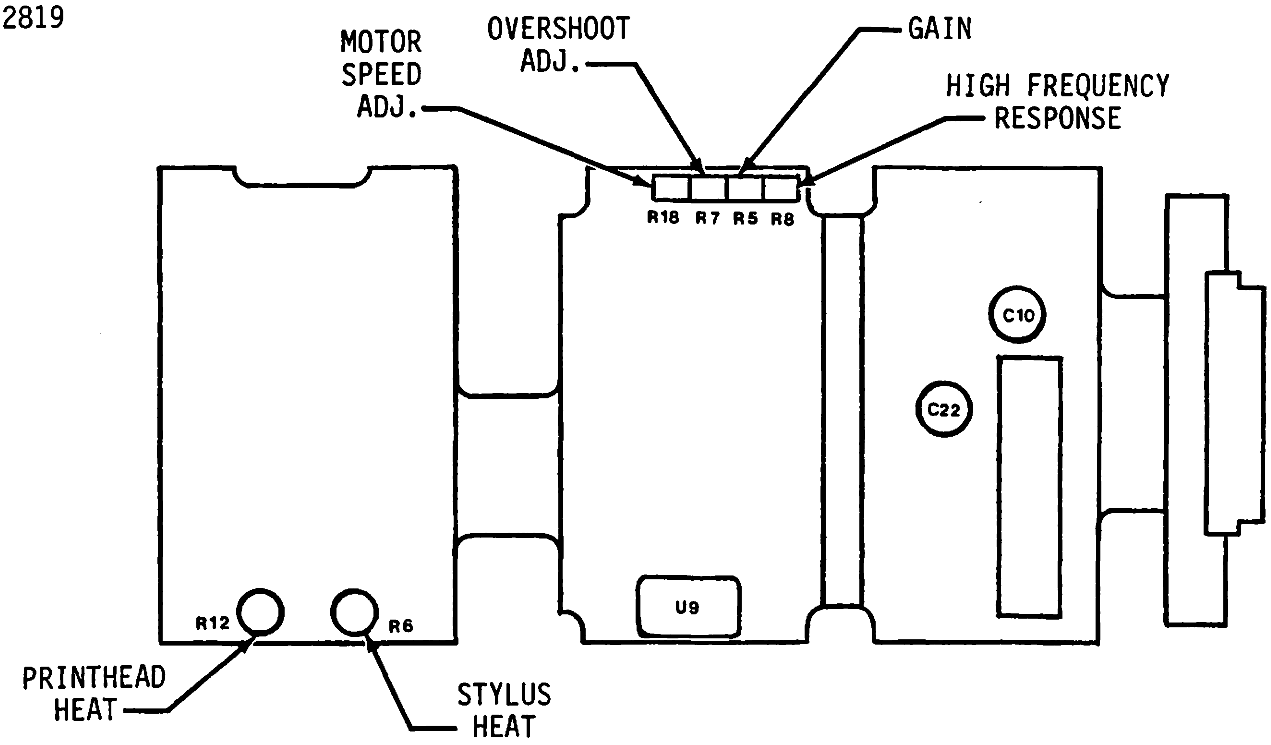
3. Verify that the trace is clearly visible and centered. Adjust R6 (MFE) or R21 (GSI) if necessary allowing 5 seconds after each adjustment for stylus temperature to stabilize.

4. Also verify that the quick heat feature produces a visible trace within 2 seconds of Recorder turn on.

5. Select STD lead position and verify that stylus does not burn Recorder paper.

C. Frequency Response and Gain. These two adjustments are interactive. Frequency response is set by balance potentiometer R8 (MFE) or R25 (GSI) and damping potentiometer R7 (MFE) or R16 (GSI), and is influenced by gain potentiometer R5 (MFE) or R1 (GSI).

MFE RECORDER PFC
802819


MOTOR SPEED ADJ.
OVERSHOOT ADJ.
GAIN
HIGH FREQUENCY RESPONSE
R18
R7
R5
R8
C10
C22
U9
R12
R6
PRINTHEAD HEAT
STYLUS HEAT

GSI RECORDER PFC
802811

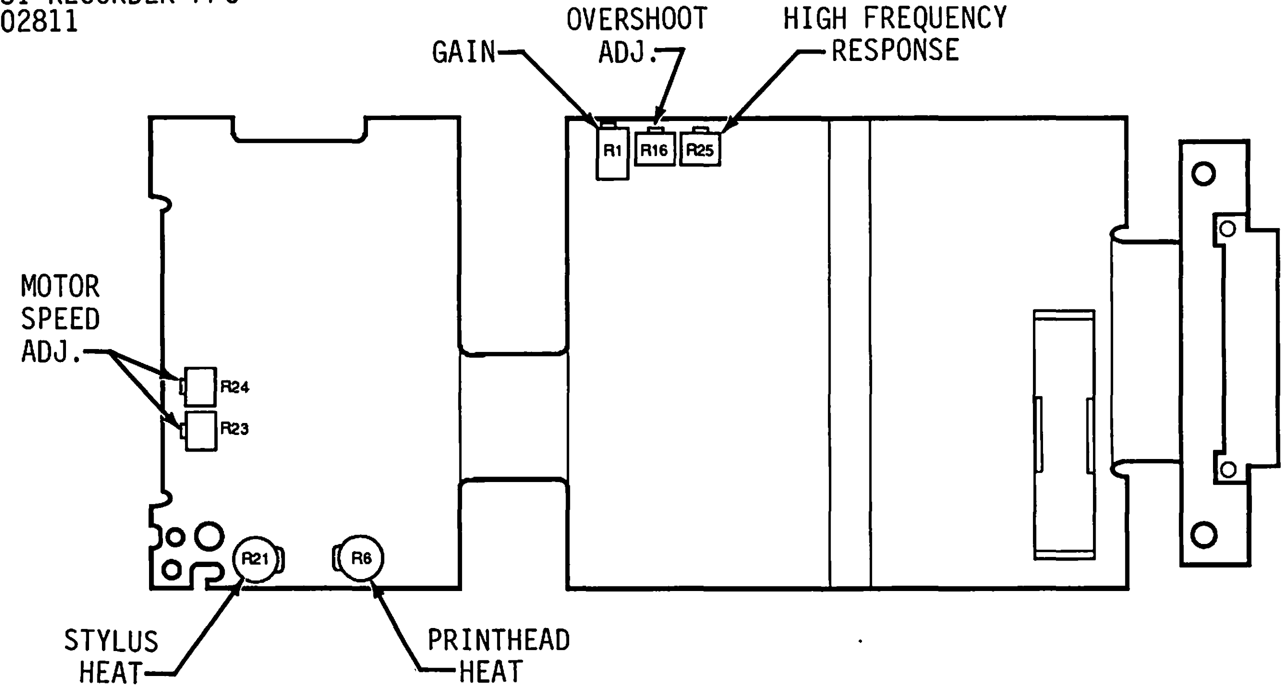

GAIN
OVERSHOOT ADJ.
HIGH FREQUENCY RESPONSE
R1
R16
R25
MOTOR SPEED ADJ.
R24
R23
R21
R6
STYLUS HEAT
PRINTHEAD HEAT

FIGURE 3-7. RECORDER PFC ADJUSTMENT LOCATIONS

1. Start calibration procedure by turning R7 (MFE) or R16 (GSI) counter clockwise to minimum setting (same potential as RN4, pin 14, see Figure 5-15).

2. Adjust ECG SIZE to X2 gain, select Lead II and input a 1Hz, 1V p-p square wave. Select 25mm/s paper speed. Press DIAG push-button.

3. Adjust R8 (MFE) or R25 (GSI) if necessary for a clean, flat square wave.

4. With the ECG SIZE adjusted to X1, input a 10Hz, 1V p-p sine wave and adjust R5 if necessary to obtain a 10.0mm p-p waveform on the Recorder.

5. Input a 100Hz, 1V p-p sine wave and adjust R7 (MFE) or R16 (GSI) if necessary to obtain a minimum 7mm p-p stylus deflection on the Recorder.

   Sweep frequency from .05Hz to 75Hz and verify that Recorder deflection is between 8.5 and 11mm p-p. Verify also that as frequency is increased to 100Hz, the Recorder deflection remains greater than 7mm p-p.

   With R7 (MFE) or R16 (GSI) properly adjusted, input a 1Hz, 1V p-p square wave and verify that overshoot is less than 0.5mm (Refer to Figure 3-8).

NOTE: Due to the interaction of R7 (MFE) or R16 (GSI) and R8 (MFE) or R25 (GSI), it may be necessary to repeat steps 3 through 5 several times before the Recorder will meet these specifications.

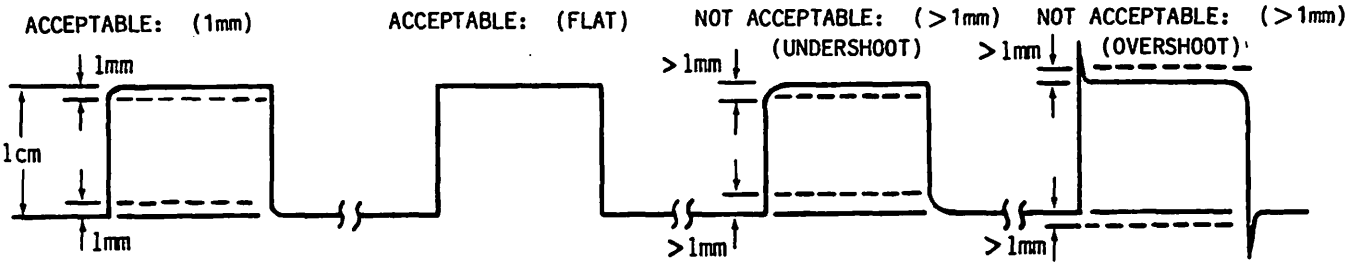


FIGURE 3-8. STYLUS DEFLECTION WAVEFORM

D. Printhead Heat. Since excessive temperature decreases printhead life, the printhead dot on-time should correspond to those listed in Table 3-4. There are three resistance classes for flexes: A, B, and C (the printhead will be marked on the plastic block or on the flex cable). Adjust the printhead on-time according to the class indicated. (Refer to Section 2 for printhead positioning instructions.)

TABLE 3-4

PRINTHEAD DOT ON-TIME AT TP5

	TYPICAL at 25mm/s	MAXIMUM at 25mm/s	TYPICAL at 50mm/s	MAXIMUM at 50mm/s
Class C 170-189 Ohms	4.9ms	5.9ms	3.0ms	3.6ms
Class B 190-210 Ohms	5.4ms	6.5ms	3.3ms	4.0ms
Class A 211-230 Ohms	5.9ms	7.1ms	3.6ms	4.3ms

1. Turn Monitor off and change Gateway PCB DIP rocker switch #4 to closed position. With this switch closed the Recorder will continuously annotate a repetitive test pattern when DIAG push button is depressed.

2. Connect oscilloscope probe to TP5 on Recorder PFC.

3. Press Monitor ON push button, press DIAG push button and set R12 (MFE) or R6 (GSI) for typical on-time at 25mm/s as listed on Table 3-4.

4. Check annotation for clarity. Readjust R12 (MFE) or R6 (GSI) if necessary but do not exceed maximum on-time listed in Table 3-4.

5. Select 50mm/s and check on-time and print quality.

   All dots should be clear with no smearing. Repeat steps 3 through 5 as required to obtain acceptable annotation.

F. Press ON push button again to turn Monitor off. Remove probe and return Gateway rocker switch #4 to the open position.

3-33. AC Power Transient Rejection.

A. Connect patient cable to ECG simulator.

B. Set QRS rate at 60 BPM and select Lead II. Set ECG SIZE to X2.

C. Set the alarm limits to 40 and 100 again.

D. Disconnect ac power.

E. Verify that the alarm limits remain at 40 and 100 after power is disconnected.

F. Verify that BATTERY legend is illuminated and that CHRG legend is off.

3-34. MONITOR SERVICE MODE FUNCTIONS

With the Monitor in Service Mode a quick closed-case check can be performed to determine that major functional blocks are operational. These service functions may also be used for troubleshooting and for CRT adjustments.

To place Monitor in Service Mode, first turn instrument off then locate the Control PCB DIP switch, accessed through a vent slot located near the bottom of the Rear Case. Move rocker switch #1 (closest to the front of the Monitor) to the closed (ON) position.

Press Monitor ON push button. After successfully completing normal power-on self-tests, Monitor will be in Service Mode. As indicated below a number of Upper Switch Panel keys now have dual functions. They retain their normal functions but can also be used to call up Service Mode functions. The Lower Switch Panel push buttons however are limited to Service Mode functions only.

Function A. Press DIAG push button to print out entire character set on Annotating Recorder.

Function B. Press HIGH ALARM increase push button to place a continuous triangle waveform on CRT.

Function C. Press DELAY push button to place the triangle waveform on the recorder (in delay mode). The waveform must be present on the CRT to enable this key. Pressing DELAY again will turn Recorder off.

Function D. Press LOW ALARM decrease push button to eliminate triangle waveform trace and to turn Recorder off.

Function E. Press CAL push button to fill the raster's alphanumeric field. Press the push button again to blank the field.

Function F. Press and hold the ALARM SILENCE push button (after blanking the alphanumeric field) to display the Monitor's accumulated hours of use.

To return to normal operating mode, turn Monitor off and set Control DIP rocker switch #1 to the open position.

3-35. MONITOR FAULT ISOLATION

Table 3-5 references key failed tests in the Functional Test and Calibration Procedure to the major assembly or assemblies most likely to be at fault. It is assumed that the Monitor has passed every test in the sequence prior to the failed test in question.

CAUTION

TO PREVENT POSSIBLE DAMAGE TO THE MAIN PFC OR TO PCBs, TURN MONITOR AC POWER OFF AND DISCONNECT BATTERIES AT J3 ON CHARGER PCB BEFORE REMOVING ANY PCBs. RECONNECT BATTERIES AFTER PCBs ARE REINSTALLED.

CAUTION

IF A SHORT CIRCUIT IS SUSPECTED IN THE INSTRUMENT, DISCONNECT BATTERIES AND OPERATE MONITOR FROM AC LINE POWER WHILE TROUBLESHOOTING TO PROVIDE BETTER EXCESSIVE CURRENT PROTECTION.

CAUTION

TO EXPEDITE FAULT ISOLATION (OR FOR TEST PURPOSES) IT MAY BE DESIRABLE TO OPERATE THE MONITOR WITHOUT ITS FULL COMPLEMENT OF PCB'S. HOWEVER, TO DO SO MAY RESULT IN DAMAGE TO THE INSTRUMENT UNLESS THE FOLLOWING GUIDELINES ARE OBSERVED.

A. Recorder and Recorder PFC may be removed without affecting any other functions. Lower Front Panel LEDs will still illuminate when Recorder control push buttons are depressed.

B. Gateway PCB may be removed; Monitor will continue to function. There will however be no ECG rate display and the SERVICE legend will be illuminated.

NOTE: The Recorder must not be activated with the Gateway PCB disconnected. Printhead damage may result.

C. ECG PCB removal will result in a flat trace but alphanumeric displays will remain active and Recorder may be operated.

D. Charger PCB may be operated with no other PCBs in Monitor to check supply voltages.

E. Control, CRT and Power Supply PCBs: none of these PCB assemblies may be operated without the other two also connected. The Charger PCB must of course be present to power these boards.

F. Front Panel PCBs may be disconnected while the Monitor is operating.

G. Rear Panel PCB must be connected if CRT is displaying a trace or alphanumerics to prevent excessive brightness and possible CRT damage.

TABLE 3-5

MONITOR FAULT ISOLATION

TESTS	STEPS FAILED	SUSPECTED ASSEMBLY
POWER-UP	3-5. A,B	Charger PCB Power Supply PCB
	D	Charger PCB Power Supply PCB Lower Switch Module PCB
	3-8. A,B	Control PCB
	C	Recorder PFC
	3-9. B	Power Supply PCB Anode Supply PCB
REAL TIME CLOCK	3-10.	Gateway PCB Recorder PFC Rear Panel PCB
LEAD SELECT LOGIC	3-11.	Control PCB ECG PCB Upper Switch Module PCB
RECORDER SPEED/ CRT TIME BASE	3-12. B	Recorder PFC Control PCB Lower Switch Module PCB
	C	CRT PCB Control PCB Upper Switch Module PCB
	D	Control PCB Upper Switch Module PCB
	E	Recorder PFC
	F	CRT PCB
ECG DISPLAY	3-13.	ECG PCB Control PCB Upper Switch Module PCB
HEART RATE	3-14.	ECG PCB Control PCB Upper Switch Module PCB
SYSTOLE BEEPER	3-15.	Control PCB Power Supply PCB Upper Switch Module PCB Speaker

TABLE 3-5 (Continued)

MONITOR FAULT ISOLATION

TESTS	STEPS FAILED	SUSPECTED ASSEMBLY
ALARM/AUTO FUNCTIONS	3-16. A,B	Control PCB Upper Switch Module PCB
	C	Recorder PFC Control PCB Power Supply PCB
	D	Rear Panel PCB
	E	ECG PCB Control PCB
	F,G	Recorder PCB Gateway PCB Control PCB Power Supply PCB
	H	ECG PCB Control PCB
	I	Control PCB Recorder PFC
	J	Control PCB
EVENT FUNCTION	3-17.	Control PCB Recorder PFC Gateway PCB Upper Switch Module PCB Lower Switch Module PCB
FREEZE FUNCTION	3-18.	Control PCB Upper Switch Module PCB
DELAY FUNCTION	3-19.	Control PCB Recorder PFC Upper Switch Module PCB Lower Switch Module PCB
DELAY RECORDER/ CRT FREQUENCY RESPONSE	3-20. A-H	Control PCB ECG PCB Recorder PFC
	J-K	CRT PCB Anode Supply PCB
DIAG. RECORDER FREQUENCY RESPONSE	3-21. A	Control PCB Lower Switch Module PCB
	C	ECG PCB Recorder PFC

TABLE 3-5 (Continued)

MONITOR FAULT ISOLATION

TESTS	STEPS FAILED	SUSPECTED ASSEMBLY
DIAG. RECORDER FREQUENCY RESPONSE (Continued)	3-21. D,E	ECG PCB Control PCB Recorder PCB
CAL FUNCTION	3-22.	ECG PCB Control PCB CRT PCB Upper Switch Module PCB
GAIN ADJUST	3-23.	ECG PCB Control PCB Recorder PFC Upper Switch Module PCB
RECORDER ANNOTATION	3-24.	ECG PCB Control PCB Gateway PCB Recorder PFC
X1 ECG OUTPUT	3-25.	ECG PCB Rear Panel PFC
PREAMP CMR	3-26.	ECG PCB
PREAMP OFFSET RECOVERY	3-27.	ECG PCB
CRT CALIBRATION	3-28. 3-29. 3-30.	CRT PCB Anode Supply PCB CRT Yoke
MFE RECORDER CALIBRATION	3-32.	Recorder PFC Recorder

3-36. MONITOR TROUBLESHOOTING GUIDE

Table 3-6, Troubleshooting Guide, provides information about possible fault in the equipment. No attempt is made to cover all possible failure modes or all possible causes for the failure in question. The Troubleshooting Guide is intended only as a supplement to the technician's diagnostic skills and his or her use of the circuit descriptions and schematics provided in this manual. The component reference diagrams in Section 6 are provided as an additional troubleshooting aid.

NOTE: Refer to CAUTION statements in paragraph 3-35 before troubleshooting Monitor.

TABLE 3-6

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
Recorder trace too light or too dark.	3-8. C	Stylus pressure out-of-adjustment.	Refer to stylus pressure calibration and verify that the stylus pressure is 5-7g.
		Stylus heat out-of-adjustment.	Refer to stylus heat calibration and adjust R6.
		Defective heat circuitry circuit.	Check stylus heat. If heat circuitry is not functioning correctly, replace stylus.
Recorder trace starts after 1 second.	3-8. C	Defective quick-heat.	Verify C10 (stylus heat circuit) is charging.
No Recorder trace.	3-8. C	Defective mechanical stylus connection.	Verify mechanical connection of stylus is good or replace stylus.
Motor drive seems to operate erratically.	3-12. B	Improper recorder paper being used.	Verify the recorder paper is the proper part number for the LP 8. Refer to paragraph 2-2.

TABLE 3-6 (Continued)

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
Some dots missing or no annotation.	3-8. B	Printhead or Printhead Drive circuit inoperative.	Check dot-on-time at U6 and U7. If pulses are present, replace Printhead. Check U5.
Annotation fades on one side or is very light.	3-8. B	Printhead not lined up with the bar on the recorder.	Check Printhead alignment.
Annotation poor in Delay mode.	3-19. D	Gateway Microcomputer not functioning properly.	Check the Microprocessor, U1 on the Gateway PCB.
Inoperative.	3-5. E	Control PCB	SW1-wrong position.
Displays pacing arrows in RECORD.	3-12.	Control PCB	U49
50mm/s bad.	3-12. D	Control PCB	U58, C9
Recorder won't run at 50mm/s.	3-12. D	Gateway PCB	U1
Unit inoperative in ac mode.	3-8. A	Charger PCB	Check ac line fuses. F1 and F2 AC/Battery control defective, check K1. Check CR6 in boot-strap Power Supply.
No CRT trace or BATTERY CHRG light.	3-7. B	Charger PCB	Gate Drive/Power Switching and Pulse Modulator defective. Check Q1, Q2 and U1. Check T2 windings. U5 defective.
Monitor turn-on inoperative.	3-7. B	Charger PCB	Open fuse in Relay Control circuit. Check F3.
Monitor won't charge a battery.	3-7. B	Charger PCB	Gate Drive/Power Switching, check Q1.
Monitor resets with multiple CAL pulses.	3-22.	Charger PCB	AC/Battery Relay Control, K1 defective.

TABLE 3-6 (Continued)

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
Clicking noise when unit operated on ac.	3-7.	Charger PCB	Relay circuit defective, check U1.
CRT display unstable under maximum load.	3-29.	Charger PCB	Switching relay defective, replace K1.
Annotation poor at 50mm/s.	3-24.	Charger PCB	Analog switch not selecting a longer dot-on time. Check U5, pin 6 for a .5ms pulse.
Recorder trace is less than or greater than 1.0cm.	3-31.	Charger PCB	Refer to paragraph 3-29 and perform step C, Recorder gain out of adjustment.
Recorder speed is off (at either speed), or can't be changed.	3-12.	Charger PCB	Refer to paragraph 3-27 and perform step A. Verify that U5 on the Recorder PFC is being switched. Check the Gateway Microprocessor, U1.
Clock/Counter malfunction.	3-10.	Charger PCB	If the Real Time Clock cannot be set as described in paragraph 3-10, check the clock frequency at TP6. It should be 36.768kHz. If it is not, check U8 or U9.
Recorder print bad and SERVICE LED lit.	3-7.	Gateway PCB	U7
Dots missing in Alpha field.	3-24. F	Control PCB	Raster controller gate array, R49.
Erratic Systole Volume.	3-15.	Control PCB	Audio interface circuitry.

TABLE 3-6 (Continued)

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
Trace offset and no ECG on CRT or Recorder.	3-8.	Control PCB	Trace controller circuitry, U65.
Intermittent FREEZE button.	3-18. C	Control PCB	Trace controller circuitry, U58.
Vertical bars in Alpha character field.	3-24. F	Control PCB	Raster Controller, U50.
Trace uneven.	3-28. D	Control PCB	Trace Controller circuitry, U58.
Bad CRT display and/ or Recorder rails in DELAY.	3-19. B 3-13.	Control PCB	Trace Controller circuitry, U65, U66.
Time and Date always on.	3-10.	Gateway PCB	Real Time Clock Interface, U14.
No ECG trace, or trace/alpha distortion.	3-8. A	CRT PCB	Dot amplifier, Intensity or Raster Amplifier circuitry, Q8, Q9, Q12, Q13, U4, U5.
	3-9. B	Anode Supply PCB	M1
		CRT Assembly	CRT Grid shorted.
Intensity uneven.	3-28. J 3-29. A	CRT PCB	Re-adjust all potentiometers.
CRT gain faulty.	3-9, 3-23.	CRT PCB	Vertical gain circuit, R68. Trace position, R3.
No Vertical deflection.	3-8.	CRT PCB	Verify all jumpers are in correct positions.
CRT gain faulty.	3-23.	ECG PCB	Gain Control and D/A, U17, U29. Isolated/ Non-Isolated Preamplifier, U4, U9, U7.

TABLE 3-6 (Continued)

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
CRT characters unstable with Recorder ON.	3-23. C	Anode Supply PCB	Voltage Controlled Oscillator frequency adjustment, R13.
Trace won't center.	3-30. B	CRT yoke adjustment tabs.	Defective Assembly.
Noisy CRT trace (any lead).	3-8. C	ECG PCB	Isolated Preamplifier circuitry, U1, U38, U12. Non-isolated Preamplifier circuitry, U9.
Distorted pacing spike on CRT and Recorder.	(Section 2)	ECG PCB	Non-isolated Preamplifier, U7, U9.
Sync notches too large on Recorder and CRT.	(Section 2)	ECG PCB	Non-isolated Preamplifier, U9.
Random sync markers.	(Section 2)	ECG PCB	Gain Control and D/A, U24.
No Sync.	(Section 2)	Power Supply PCB	Sync Signal Decoder, U24.
No input or lost or intermittent ECG Signal.	3-8. 3-13.	Power Supply PCB	Isolated/Non-isolated Preamplifier, T1, T2.
No QRS detect.	3-8. A	Power Supply PCB	QRS detection, U19 pin 20.
No cal pulse and/or SERVICE lights.	3-22.	Power Supply PCB	Flyback Detection, C7.
Re-boots when Recorder is turned on.	3-8. B	Power Supply PCB	Flyback Detection, C7.
Draws excessive current	3-6. B	Power Supply PCB	Flyback Detection, Q9
or			or
Power Supply loads down when Recorder is turned on	3-8. B	"	transformer Drive, CR12, Q10, Q11
or			or
Alpha field degenerates.	3-28. G	"	Battery Protection, U5.

TABLE 3-6 (Continued)

MONITOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
+5V UNSW faulty.	3-9.	Power Supply PCB	Battery protection, U5.
Quit during I/F wake-up	(Section 2)	"	Wake-up Suppression, U26, U27, U28.
or Defibrillator causes Monitor to cycle ON/ OFF at wake-up rate	"	"	Defibrillator Serial Data Receiver, U32.
or No wake-up.	"	"	

3-37. DEFIBRILLATOR FUNCTIONAL TEST AND CALIBRATION

Procedures provided here may be used to verify that the LIFEPAK 8 Defibrillator is operating within specifications. If the instrument is not functioning properly, locate and correct the malfunction before proceeding.

WARNING

THE LIFEPAK 8 DEFIBRILLATOR STORES AND DELIVERS A POTENTIALLY LETHAL AMOUNT OF ENERGY WHEN DISCHARGED. BEFORE ATTEMPTING TO WORK ON THIS INSTRUMENT ALL PERSONNEL MUST BE FAMILIAR WITH IT.

THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN:

A. BEFORE REMOVING COMPONENTS OR DISCONNECTING ANY PCB ASSEMBLY, DISCONNECT THE DEFIBRILLATOR FROM THE AC POWER SUPPLY. DISCONNECT THE BATTERY CONNECTION FROM P17A ON THE DEFIBRILLATOR POWER SUPPLY PCB.

B. DISCHARGE THE ENERGY STORAGE CAPACITOR AND C4 AND C5 ON THE POWER SUPPLY PCB ASSEMBLY USING AN INSULATED RESISTOR 5K TO 20K OHM, 50W, 5KV. THE RESISTOR SHOULD BE CONNECTED DURING ALL WORK ON THE DEFIBRILLATOR, UNTIL THE INSTRUMENT IS READY TO OPERATE. THE PROBE OR CLIPS USED TO CONNECT THE RESISTOR SHOULD BE INSULATED TO WITHSTAND 20KV.

3-38. Initial Setup.

A. Disconnect the Defibrillator from the line power source. Remove Rear Case as described in Section 4. Disconnect the Battery by removing the red wire from P17A on the Power Supply PCB Assembly.

B. Connect an ammeter between the red battery lead and quick disconnect terminal P17A on the Power Supply PCB Assembly. Verify that the current drain from the battery is less than 5mA.

C. Select the Defibrillator test mode by connecting a jumper between TP1 and TP10 on the Logic PCB Assembly. Set R3, R1, and R19 on the Logic PCB Assembly to mid range.

3-39. Power-On.

A. Connect ac line power. Verify that the battery charge current is between 90 and 115mA. Remove ac line power.

B. Depress the ON push button and verify that the ON LED illuminates. Observe the front panel and verify that the Defibrillator is in the display test mode. The display legends and the digits illuminate in the following sequence.

State (Not Displayed)	Low Energy Digits	Energy Display Digits	LEDs & Legends	Audible Alerts
0	0	1 2 3	LOW BATTERY	1600Hz
1	1	2 3 4		400Hz
2	2	3 4 5	SERVICE	
3	3	4 5 6	CHRG	
4	4	5 6 7	SYNC	
5	5	6 7 8	MODE	
6	6	7 8 9	LOW SELECT	
7	7	8 9 0	AVAILABLE	
8	8	9 0 1	ENERGY	
9	9	0 1 2	TEST	
10	Blank	Blank		
11	Blank	Blank		
12	Blank	Blank		
13	Blank	Blank		
14	Blank	Blank		
15	Blank	Blank		
16	Blank	Blank		

Verify that the BATTERY legend is always on and that the LOW SELECT legend is illuminated when the low energy digit displays 0-9.

NOTE: The SERVICE legend will remain on if the Defibrillator fails any of the following power-on self tests.

- Controller Serial Data, Data Packet Grouping Error
- Controller Watch Dog Time Out

- Test Mode Conflict
- Sync Legend Failure
- Controller Serial Data, Check Byte Error
- Transfer Drive Failure
- Voltage Reference Failure
- Battery Charger Failure
- Transfer Timing Failure
- Pacing Serial Data Failure
- Pacing Watch Dog Failure

C. Simultaneously press both low energy select push buttons (▽ and △) and set ENERGY SELECT to 50J. Verify that the current drain from the battery is less than 400mA.

D. Select the 10A scale on the ammeter. Cycle the Defibrillator power and press the low energy select push buttons simultaneously. With ENERGY SELECT still set at 50, depress the CHARGE push button. Verify that the Defibrillator is charging by flashing CHARGE and Apex paddle LEDs and an audible whine is emitted from the instrument. Verify that the energy display increases. At full charge, an audible tone is generated. At the same time, the whine will cease and the CHARGE LED, ENERGY display, and paddle LED will remain on, indicating that the Defibrillator is ready for transfer. The Defibrillator will refresh the charge on the Energy Storage Capacitor every few seconds. Verify that the available energy legend is on.

CAUTION

DO NOT LET DEFIBRILLATOR CHARGE FOR MORE THAN 7 SECONDS.

E. Verify that with the Defibrillator charged the battery current is 460 ± 90mA. Connect ac power and cycle power to Defibrillator. Press ▽ and △ low energy select push buttons simultaneously as in step C.

F. Place the paddles on the energy meter (see Table 3-1) and charge the Defibrillator. Depress both discharge push buttons. Verify that energy transfer occurs. Record the energy measurement.

G. Depress the Apex paddle CHARGE button. When charging stops, adjust the energy display potentiometer (R3 on the Logic PCB Assembly) until the ENERGY window display reads the energy value that was recorded in the previous step. Adjust the delivered energy potentiometer (R19 on the Logic PCB Assembly) until the ENERGY window displays 50J. Discharge the Defibrillator into the energy meter and verify that 50 ±3.5J is delivered. If the energy value is out of tolerance, repeat this step using the latest value of delivered energy instead of original value obtained in step F.

H. Depress the Apex paddle CHARGE button. With the paddles stowed in the unit, depress the apex discharge button only; then the sternum discharge button only. Verify that the unit discharges only when both discharge buttons are depressed, not one.

3-40. Charge Time and Ready Tone.

Jumper at TP1 and TP10 must be removed and power cycled. After performing tests A and B. Replace jumper and cycle power.

A. Remove the jumper at TP1 and TP10. Cycle power.

B. Set ENERGY SELECT to 360J. Simultaneously start the stopwatch and press the CHARGE push button. Verify the time from the beginning of charge to when the charge indicator stops blinking is between 9.0 and 9.8 seconds. Also verify that a tone sounds when the Defibrillator is fully charged.

C. If the charge time is out of tolerance, adjust R25 and R26. While charging up the Energy Storage Capacitor, adjust R25 for a charge time within tolerance and adjust R26 for maximum frequency of the waveform, with minimum ringing. R25 and R26 interact.

D. Reinstall the jumper at TP1 and TP10. Cycle power.

3-41. Charge Calibration.

A. Set ENERGY SELECT to 360J and charge the Defibrillator. Discharge the Defibrillator into the energy meter and verify that the delivered energy is 360 ± 22J. If the energy is out of tolerance, charge the Defibrillator again and adjust R3 so that the ENERGY window displays the value just delivered. Then adjust R19 so the ENERGY window displays 360J.

B. Charge and transfer the Defibrillator at every available energy setting, pausing 20 seconds between each transfer. For each setting, record the reading given on the Defibrillator ENERGY display immediately after the Defibrillator finishes charging. Also record the energy reading measured on the energy meter after the energy has been transferred. Verify that the values are within the following tolerances:

ENERGY SELECT	ENERGY DELIVERED	DEFIBRILLATOR ENERGY DISPLAY
1J	1 ± .1J	1 ± 0
2J	2 ± .2J	2 ± 0
3J	3 ± .3J	3 ± 0
4J	4 ± .4J	4 ± 0
5J	5 ± .5J	5 ± 0
6J	6 ± .6J	6 ± 0
7J	7 ± .7J	7 ± 0
8J	8 ± .8J	8 ± 0
9J	9 ± .9J	9 ± 0
10J	10 ± 1J	10 ± 1
20J	20 ± 2J	20 ± 1
30J	30 ± 3J	30 ± 2
50J	50 ± 5J	50 ± 3
100J	100 ± 6J	100 ± 7
150J	150 ± 9J	150 ± 10
200J	200 ± 12J	200 ± 12
300J	300 ± 18J	300 ± 14
360J	360 ± 22J	360 ± 16

NOTE: Some readjustment of R19 (for delivered energy) and R3 (for ENERGY display) may be required to make all the values fall within tolerance. Also, the ENERGY display must read the same at the end of charge and after each refresh, but is allowed to drift down by 1 digit (on 1-20J range) and by the listed tolerance (all other ranges) between refresh cycles.

C. Stow the paddles in the Defibrillator storage receptacles. Depress the SYNC push button. Verify the ENERGY TEST legend is illuminated. Charge the Defibrillator to 360J and transfer energy into the test load. Adjust R1 so that the ENERGY window displays 360J.

D. Set ENERGY SELECT to 100J. Charge the Defibrillator and then transfer the energy into the test load. Verify that the energy window displays 100 ± 7J.

E. Depress the ON push button to turn off the Defibrillator. Remove the jumper between TP1 and TP10 on the Logic PCB Assembly.

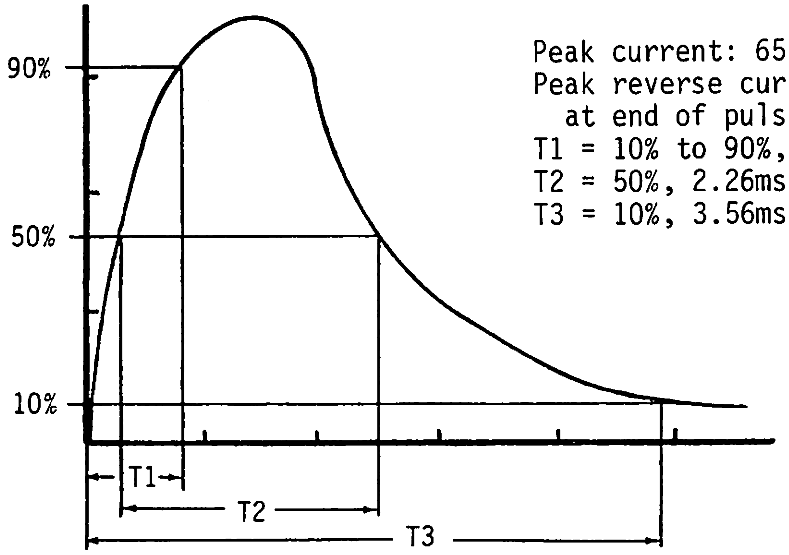
3-42. Multiple Charge and Discharge.

A. Depress the ON push button. Set ENERGY SELECT to LOW for preselected 5J.

B. With the paddles stowed in the Defibrillator storage receptacles, continuously depress both transfer push buttons and initiate charge cycles every 2 seconds for 15 cycles. Verify that there is no loud popping in the transfer relay and that the Defibrillator remains operational.

3-43. Output Waveform.

A. Connect the oscilloscope to the 1000:1 output on the energy meter. Set the scope to .5V/div and 1ms/div. Set ENERGY SELECT to 360J and charge the Defibrillator. Discharge energy into the energy meter. Verify that the stored output waveform conforms to the parameters shown in Figure 3-9. Current is found by multiplying the voltages seen on the scope by 20.



Peak current: 65.0A ± .5A to 51.5A
Peak reverse current: 0 to 18A (measured at end of pulse)
T1 = 10% to 90%, .48ms to 1.42ms
T2 = 50%, 2.26ms to 4.02ms
T3 = 10%, 3.56ms to 8.74ms

FIGURE 3-9. OUTPUT WAVEFORM PARAMETERS

3-44. Charge Current.

A. Disconnect the Defibrillator from ac line power. The ammeter should still be connected between the red battery lead and P17A. Depress ON push button and set ENERGY SELECT for 360J. Depress the CHARGE push button. Verify that the current does not exceed 10A. Transfer the charge and reconnect the ac line power.

3-45. Ready Time and Refresh Action.

A. Set ENERGY SELECT to 360J and charge Defibrillator. Start the stopwatch when charge indicator stops blinking. Stop the stopwatch when the first refresh occurs. Verify that this time is greater than 8 seconds.

B. Transfer the energy and charge the Defibrillator up to 360J again. Start the stopwatch when the Defibrillator reaches full energy. Stop the stopwatch when ENERGY display and CHARGE LED extinguishes. Verify that this time is 60 ± 5 seconds and that the energy cannot be transferred.

C. Depress the CHARGE push button. When Defibrillator reaches full charge, verify that the energy display reads 360J until the first refresh occurs.

3-46. Internal Dump and Open Air Discharge.

A. Charge the Defibrillator to 360J. Change the ENERGY SELECT switch to LOW and depress the CHARGE push button. Verify that the charge indicator and AVAILABLE ENERGY legend extinguish, and that the ENERGY display decreases and then remains at 5J. Verify that the time required to reduce charge from 360 to 5J is less than 10 seconds.

B. Charge the Defibrillator to 360J. Hold the paddles at least one foot apart in open air and simultaneously press both discharge buttons. Verify ENERGY display flashes, indicating abnormal discharge. Stow the paddles into the Defibrillator storage receptacles and verify that the Defibrillator will properly transfer the energy.

3-47. Interlock Test.

A. Stow the paddles in the Defibrillator storage receptacles. Insert the Extender Type 5 PCB Assembly into the cassette receptacle. Connect pins 11, 18, and 24 together.

CAUTION

IF THE EXTENDER CABLE IS INSERTED INCORRECTLY, ONE OF THE FUSES MAY BLOW AND SHORT THE BATTERY.

B. Set ENERGY SELECT 50J. Verify that the Defibrillator charges and transfers into the test load.

C. Set ENERGY SELECT 100J. Verify that the Defibrillator charges but will not transfer. Dump the charge by turning the ENERGY SELECT switch to another setting.

D. Remove the paddles from the Defibrillator and connect them to the energy meter. Verify that the Defibrillator (set at 100J) charges and transfers.

E. Disconnect pin 11 and leave pins 18 and 24 connected. Set ENERGY SELECT to 50J. Stow the paddles and verify that the Defibrillator charges but does not discharge. Dump the charge by turning the ENERGY SELECT switch to another setting.

F. Disconnect pins 18 and 24 and connect pins 9 and 24. Verify that the SERVICE legend illuminates and that a continuous tone sounds. Disconnect pins 9 and 24.

3-48. Cassette Interface Test.

A. Cycle power to the Defibrillator and verify the following voltages on the Extender Type 5 PCB Assembly:

Less than .2Vdc: on pins 1, 2, 5-7, 17, 22, 24, 25, 27, 28

12 ± .5Vdc: on pins 29, 30

5 ± .25Vdc: on pins 3, 23

B. Connect pins 18 and 24 and momentarily short pin 23 to pin 2. Verify that the pin 1 voltage is 12 ± .5Vdc.

C. Charge the Defibrillator. Verify that the voltage at pin 3 is less than .2Vdc.

D. Discharge the Defibrillator into the energy meter and verify that pin 3 increases to 5V between 2 seconds and 4 seconds after discharge.

E. Remove the Extender Type 5 PCB Assembly.

3-49. Battery Mode.

A. With the Defibrillator power on, remove the ac line power and verify an audible "beep" indicating loss of ac. Verify that the Defibrillator charges and transfers normally.

3-50. DEFIBRILLATOR TROUBLESHOOTING GUIDE

Table 3-7, Defibrillator Troubleshooting Guide, provides information about possible fault in the instrument. No attempt is made to cover all possible failure modes or all possible causes for the failure in question. The Troubleshooting Guide is intended only as a supplement to the technician's diagnostic skills and his or her use of the circuit descriptions and schematics provided in this manual. The component reference diagrams in Section 6 are provided as an additional troubleshooting aid.

NOTE: Refer to WARNING statements in paragraph 3-37 before troubleshooting the Defibrillator.

TABLE 3-7

DEFIBRILLATOR TROUBLESHOOTING GUIDE

SYMPTOM	TP STEP	SUSPECTED PART/ASSY	COMPONENT/CIRCUIT CORRECTIVE ACTION
Defibrillator does not function when ON is depressed.	3-39. B	Power Supply PCB Batteries Main PCB	Fuses, CR4, CR5, CR8, CR9, Q1, Q2. Q24, CR37, CR38
Defibrillator does not charge when CHARGE is depressed.	3-39. D	Main PCB Logic PCB	Q9, Q24, CR37, CR38 U19, U21
Defibrillator fails to transfer energy after charge.	3-39. F	Main PCB Logic PCB Paddles	Q24, CR37, CR38, U7 U8, Q13, Q19, S1, S2
No PADDLES monitoring (Quik-Look ECG).		Main PCB Optical Interface PCB	Q24, CR37, CR38, Q1, U1-U3 CR1
Batteries are not being charged.	3-39. A	Power Supply PCB Batteries Main PCB Rear Panel	F7, F8, U3, Q5 MAINS POWER switch must be in ON position.
TEST LOAD display does not read selected 100J or 360J.	3-40. C,D	Logic PCB	Test load contacts S1, S2.
Defective SYNC function.		Optical Interface PCB Main PCB Logic PCB	Q1
Energy display is out of tolerance.	3-39. G 3-40. A,B	Main PCB Control PFC Logic PCB	U27, R38, R39 U10

3-51. PACING CASSETTE FUNCTIONAL TEST AND CALIBRATION

Procedures provided here may be used to verify that the LIFEPAK 8 Pacing Cassette is operating within specifications. If the instrument is not functioning properly, locate and correct the malfunction before proceeding.

3-52. Initial Test Setup.

A. Connect the LP 8 Defibrillator to the LP 8 Monitor (see Connecting the Instruments, paragraph 2-4).

B. With both the Monitor and Defibrillator turned off, carefully align the connector pins and insert the Extender Type 5 Cable Assembly (803525) into the Defibrillator Cassette Receptacle.

CAUTION

IF THE EXTENDER CABLE ASSEMBLY IS MISALIGNED WHEN CONNECTED TO THE DEFIBRILLATOR, A FUSE MAY BLOW IN THE DEFIBRILLATOR.

C. Disassemble the Pacing Cassette according to the Pacing Cassette Case Separation procedure in Section 4.

NOTE: The Pacing Cassette Control Label (802946) cannot be reused. Replace the Control Label when reassembling the instrument.

D. Connect the Pacing Cassette to the Extender Cable.

3-53. Power-On.

A. Depress Defibrillator ON push button.

B. Verify that the frequency at U9, pin 40, on the Pacing Cassette PFC Assembly is 1.0MHz ± .01MHz.

C. Verify that the voltage at U11, pin 16, on the Pacing Cassette PFC Assembly is 5.1Vdc ± .1Vdc.

3-54. Pacing Waveform.

A. Install 50 Ω load (see Figure 3-1) between red and black connections on pacing cables and attach oscilloscope as shown in Figure 3-10.

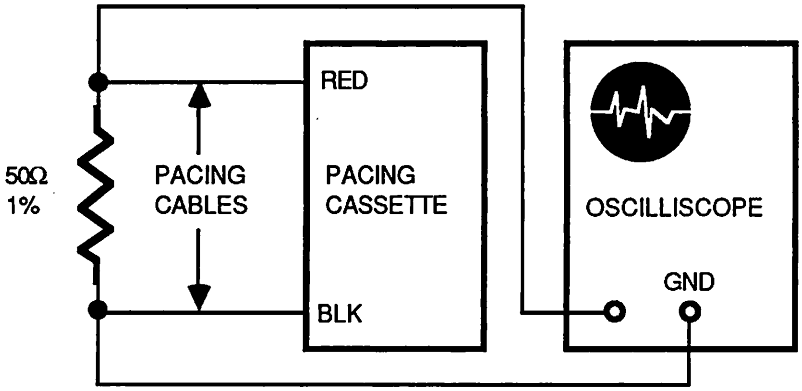


FIGURE 3-10. CASSETTE LOAD CONNECTIONS

B. Set the oscilloscope to 5ms/div, 2V/div, single sweep, store mode, + slope.

C. Adjust the Pacing Cassette CURRENT control to 200mA.

D. Depress the NON DEMAND push button and then the START STOP push button to enter pacing mode.

E. Measure the peak and droop voltages, and the pulse width (at 50% of the peak voltage) shown in Figure 3-11. Verify that the values are within the following specifications:

Peak voltage: 11V ± .25V
Droop voltage: 74 to 85% of peak voltage
Pulse width: 20 ± 0.1ms

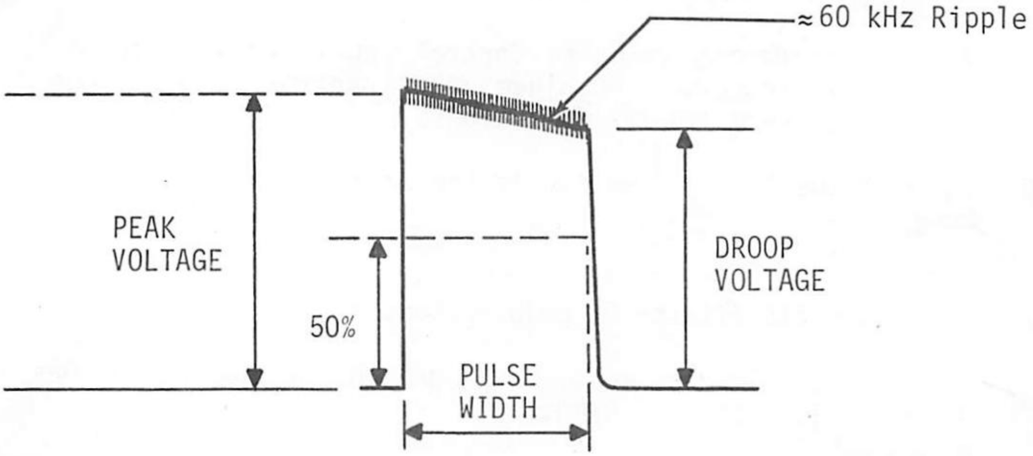


FIGURE 3-11. PACING WAVEFORM

F. If the peak voltage is out of tolerance, adjust R66.

G. Verify that the leading edge of the waveform is slightly rounded and a spike is not present.

H. Depress START STOP and then the NON DEMAND push buttons. Verify all indicators on the Pacing Cassette are not illuminated.

I. Disconnect the Pacing Cassette from the Extender Cable. Reassemble the Pacing Cassette.

SECTION 4
SERVICE AND MAINTENANCE

4-1. OVERVIEW

This section provides service and maintenance procedures for the LIFEPAK 8. Included are a List of Tools and Materials required, Disassembly and Assembly Procedures, Inspection, Cleaning and Repair Techniques.

4-2. TOOLS AND MATERIALS

Following is a list of recommended tools, materials and chemicals to have available for maintenance and repair activities.

4-3. List of Tools and Materials for Cleaning Activities.

A. Vacuum cleaner.

B. Nonmetallic, soft-bristle brush.

C. Clean, lint-free cloth.

D. Dry, low pressure compressed air (60 psi).

E. Isopropyl alcohol, 99% pure (preferred solvent).

F. Ethyl alcohol, Fed-Std O-E-760, Grade 1, Class A or B.

G. Perchloroethylene.

NOTE: The above equipment and solvents are either standard shop commodities or are available from commercial sources.

4-4. List of Tools and Materials for Repair Activities.

A. Crocus cloth, available from commercial sources.

B. Solder, activated rosin-core, tin-lead wire Sn 60 or Sn 63 Type R or RMA per Federal Specification QQ-S-571d.

C. Sleeving, silicone-treated fiberglass, Class HA1 or HC1 per MIL-I-3190 or equivalent.

D. 5-Minute Epoxy - Manufactured by Devcon Corporation, 59 Endicott Street, Danvers, Massachusetts, 01923.

E. Solder Vacuum Part Number LTS13 - Manufactured by EDSYN Inc., 15954 Arminta Street, Van Nuys, California, 91406.

F. Isopropyl alcohol, 99% pure, available from commercial sources.

G. Trichloroethylene.

H. Acid brush and cotton swabs.

4-5. MONITOR DISASSEMBLY PROCEDURE

The following procedures provide a logical sequence for removing the major components of the LP 8 Monitor. Special disassembly notes are provided as required. Refer to Figure 5-4 drawings and parts list. The numbers in parentheses refer to item numbers in that parts list unless otherwise stated.

CAUTION

DISASSEMBLY SHOULD ALWAYS BE ACCOMPLISHED WITH THE AC POWER CORD DISCONNECTED FROM THE AC POWER SOURCE.

CAUTION

ALL ASSEMBLIES WITH RED PCBs CONTAIN STATIC SENSITIVE DEVICES ⚠ ATTENTION (SSDs). USE SPECIAL HANDLING PROCEDURES.

4-6. Rear Case Removal.

A. Disconnect line cord from Rear Case (6) and make certain that the Mains Power on the Rear Panel is turned off.

B. Remove two long screws (36) from handle area and eight additional screws (31) securing Rear Case to Front Case (5).

C. Separate Rear Case and Handle Insert (15) from the instrument.

NOTE: The Monitor is now ready for calibration adjustments. No further disassembly is required unless the Recorder PFC needs to be adjusted.

4-7. Rear Panel Assembly Removal.

After Rear Case Removal proceed as follows:

A. Remove one flat head screw (33) and two pan head screws (37) securing Rear Panel Assembly (22) to instrument.

B. Carefully remove SIP Main Flex Connector from J1 on the Rear Panel PCB. The Rear Panel Assembly may now be placed to one side.

CAUTION

IF FURTHER DISASSEMBLY IS REQUIRED, FIRST DISCONNECT THE BATTERIES AT J3 ON THE CHARGER PCB.

C. To remove Rear Panel Assembly from instrument, disconnect J1 and J3 on Charger PCB. Separate Rear Panel Assembly from the Monitor.

4-8. Charger PCB Removal.

After Rear Case and Rear Panel Assembly removal proceed as follows:

A. Disconnect wires at J1 and J3 on Charger PCB (A3).

B. Slide Charger PCB out of the Monitor along its card guides.

4-9. Control PCB Removal.

After Rear Case removal proceed as follows:

Carefully slide Control PCB (A6) out of Monitor along its card guides.

4-10. ECG PCB Removal.

After Rear Case and Control PCB removal proceed as follows:

Slide ECG PCB (A4) out of Monitor along its card guides.

4-11. Power Supply PCB Removal.

After Rear Case and Rear Panel Assembly removal proceed as follows:

A. Disconnect J3 (at top) and J2 (at bottom) of Power Supply PCB (A2).

B. Carefully slide Power Supply PCB out of Monitor along its card guides.

4-12. Gateway PCB Removal.

After Rear Case and Rear Panel Assembly removal proceed as follows:

Carefully slide Gateway PCB (A5) from Monitor along its card guides.

4-13. CRT Assembly Removal.

CAUTION

THE CRT PCB IS STATIC SENSITIVE. DO NOT TOUCH ELECTRONIC COMPONENTS OR THE CIRCUIT SIDE WHEN REMOVING ASSEMBLY.

After Rear Case, Rear Panel Assembly, Charger PCB and Power Supply PCB removal proceed as follows:

The CRT PCB carries the CRT Assembly (See Figure 5-5). To disconnect from Main Flex, grasp large heat sink at rear of CRT PCB by the base and slide Assembly out of Main Flex connector. Then hold the CRT Assembly by the yoke and slide the entire Assembly out of Monitor along its card guides.

4-14. CRT Removal. (Refer to Figure 5-5.)

After removing CRT Assembly from Monitor, proceed as follows:

A. Slip rubber Front Mount (4) forward and off of the CRT.

B. Loosen and remove Yoke Retainer Clamp (7). To open clamp, slide mating halves apart laterally. To secure clamp, push mating halves directly into each other.

C. Carefully remove the Connector Assembly (2) from the CRT pins.

NOTE: When the Monitor has been turned off for over 60 seconds, the small charge remaining on anode cap may be discharged through a jumper to COM side of C4 (Anode Supply PCB). See schematic Figure 5-14.

D. Discharge and remove Anode Cap (part of A8) and disconnect Yoke Assembly at J2 on CRT PCB.

E. Separate CRT and Yoke (51) from CRT Assembly.

F. Slide Yoke from neck of CRT.

4-15. Anode Supply PCB Removal (Refer to Figure 5-5.)

After removing CRT Assembly from Monitor, proceed as follows:

A. Remove two screws (8) securing PCB to CRT Assembly.

B. Disconnect +400V lead at J2 on PCB.

C. Discharge the high voltage anode (see NOTE paragraph 4-14), then disconnect it from the CRT.

D. Carefully separate Anode Supply PCB from CRT PCB to disconnect P1 from J4 on the CRT PCB.

NOTE: Be careful when reconnecting P1 and J4 to avoid damaging components on the CRT PCB.

4-16. Lower Front Panel Assembly Removal. (Refer to Figures 5-3 and 5-4.)

The Lower Front Panel Assembly has two mounting tabs along the top edge, a projecting tab and a catch along the bottom edge.

A. To release top left mounting tab, depress tab with the flat blade of a stylus adjustment tool or a thin screwdriver and simultaneously pull the upper left corner of Panel slightly forward.

Depress top right tab as above and again move Panel slightly forward to release tab.

B. With both top mounting tabs released, rotate top of Panel outward until the tabs clear the Front Case. Stop.

The bottom edge of the Lower Front Panel has a catch on the right and a projecting tab on the left. This tab locks the recorder latch.

C. To free the projecting tab, raise the Panel approximately 1/8" then lift the left side. This will release the Panel.

D. Carefully disconnect Main Flex connector at J1 on Lower Front Panel PCB and remove Assembly from instrument.

NOTE: When replacing Lower Front Panel in Front Case, first place recorder locking tab in position then rotate upper mounting tabs into Front Case slots.

4-17. Upper Front Panel Assembly Removal. (Refer to Figures 4-1 and 5-4.)

A. Disconnect line power and battery power.

B. Remove two long screws (36) above Rear Case (6) handle.

C. The Upper Front Panel Assembly slides up within its molded recess in the Front Case (5).

Start by releasing the right side retaining tab as follows: while exerting a gentle upward pressure on Upper Front Panel, slip flex removal tool (see Table 3-1 for part number) into seam between Front Panel and Front Case as indicated in Figure 4-1. Slide tool upward about 1 inch. A click may be heard when tab releases. Repeat process for left side.

When both tabs are released, the Upper Front Panel Assembly will slide up and out of Front Case.

D. Carefully remove Main Flex connector at J1 on Upper Front Panel PCB and remove Assembly from instrument.

NOTE: When replacing Upper Front Panel Assembly in Front Case, first reconnect Main Flex at J1 then place the two screw tabs (at top of Front Panel) into slots on top of Front Case. With bottom of Front Panel about 1/4 inch above its normal position, push in the retaining tabs so that the Front Panel can drop in flush with front of Case. Then slide Front Panel down until both tabs click into locking position.

4-18. Recorder Assembly Removal. (Refer to Figures 4-1 and 5-4.)

After removing the Lower Front Panel Assembly proceed as follows:

Open the Recorder Paper Carriage. Use a flat bladed screwdriver and press the black plastic Recorder latch (at lower right front of Recorder) to the right. Simultaneously pull Recorder forward holding the Paper carriage close to its hinge. Slide Recorder Assembly out of Recorder Housing (14) along its Card Guides (13).

4-19. Recorder PFC Removal.

After removing the Lower Front Panel Assembly and the Recorder Assembly, proceed as follows:

A. Disconnect ribbon cable at J2 on Recorder PFC (3).

B. Remove two screws (35) securing PFC to Recorder Mounting Plate (26).

C. Remove four screws (34, MFE only) securing PFC to Recorder and separate the folded PFC from the Recorder.

To separate the GSI PFC from the GSI Recorder, proceed as follows:

D. Remove 3 screws (33) to separate Recorder mounting plate from recorder.

E. Loosen screws on PCB Retaining Clips (refer to Section 5, Figure 5-7B) and pull PFC free of the Recorder.

F. If necessary, the printhead flex may also be disconnected from J5 on the Recorder PFC. Carefully separate these connectors; do not attempt to disconnect by pulling the printhead flex.

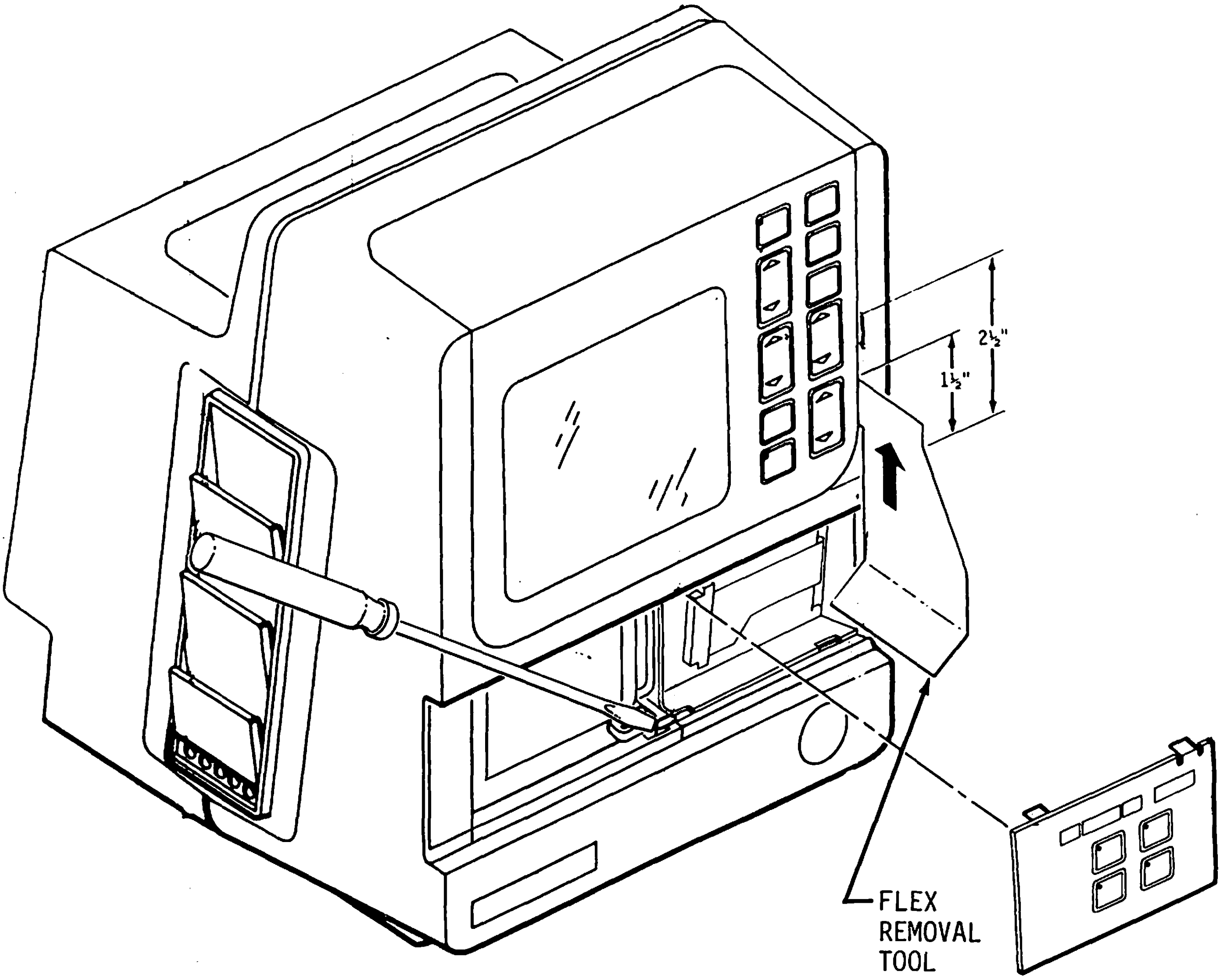


FIGURE 4-1. RECORDER AND UPPER FRONT PANEL ASSEMBLY REMOVAL

To unfold the PFC, proceed as follows:

G. Disengage two Locking PCB Retainers (30) securing the upper section of PFC to the middle section and carefully unfold upper section of PFC.

H. Carefully disengage the four locking Retainers (31) from the middle section of PFC. Then remove from the bottom PFC section the two Locking Retainers closest to the Recorder Mounting Plate. This is necessary so that the flex is not stressed when unfolding the middle and bottom sections of PFC.

4-20. Batteries Removal.

After removing Lower Front Panel Assembly and Recorder proceed as follows:

There are two sets of battery packs stored beneath the Recorder Assembly (A13).

A. Disconnect and remove the battery pack on the left first.

B. Slide the other battery pack to the left and disconnect and remove it.

4-21. Main PFC Removal.

After removing all the above components and assemblies proceed as follows:

A. Remove four screws (37) securing Recorder Housing (14) to the Front Case (5).

B. Remove two screws (35) securing J11, Main Flex Recorder Connector, to the Recorder Housing.

C. Move J11 first and then Rear Panel connector J10 through slot in Recorder Housing to left of speaker.

D. Remove Recorder Housing from Front Case.

E. Remove two screws (35) securing Main Flex optical interface board to Connector Module (10), then remove one screw (37) securing Connector Module to Front Case standoff.

F. Remove eight additional screws (35) securing Main PFC Case and carefully separate Flex from Front Case.

4-22. DEFIBRILLATOR DISASSEMBLY PROCEDURE

The following procedures provide a logical sequence for removing the major components of the LP 8 Defibrillator. Special notes are provided as required. Refer to Figure 5-24 drawing and parts list. Parenthetical numbers in the disassembly procedure refer to item numbers in the parts list.

CAUTION

DISASSEMBLY SHOULD ALWAYS BE ACCOMPLISHED WITH THE AC POWER CORD DISCONNECTED FROM THE AC POWER SOURCE.

CAUTION

ALL ASSEMBLIES WITH RED PCBs CONTAIN STATIC SENSITIVE DEVICES ⚠ (SSDs). USE SPECIAL HANDLING PROCEDURES.

4-23. Rear Case Removal.

A. Disconnect line cord and ensure Defibrillator is turned off.

B. Remove eight screws(45), (44)securing Rear Case to the Chassis.

C. Slide the Rear Case (6) off, away from the Defibrillator.

NOTE: The Defibrillator is ready for calibration adjustments.

4-24. Chassis Removal.

A. Remove paddles from storage receptacle and lay along side the Defibrillator.

B. Remove Lower Front Panel by carefully prying down the two sides of the coil cord opening, as shown below, and then disconnect flex circuit from P4.

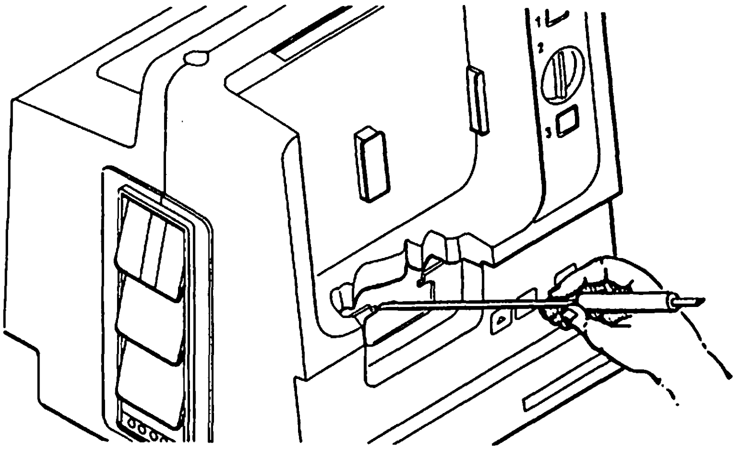


FIGURE 4-2. LOWER FRONT PANEL REMOVAL

C. When the Lower Front Panel is unlatched and rotated down, remove four screws (43).

D. Slide the Front Case away from the Chassis.

NOTE: Several cables and flex circuits connect the Chassis to the upper Front Panel, use care when separating the Chassis so the connecting cables will not be damaged.

NOTE: During reassembly, reed switches SW1 and SW2 on the Logic PCB can be easily damaged. To avoid damage, tip Chassis forward slightly by lifting the back end while sliding the Chassis into Front Case.

4-25. Battery Pak Removal.

After completing Chassis Removal, steps A and B, proceed as follows.

There are two battery paks (2) stored beneath the conduit cover (13).

A. To remove either battery pak, pull tape tab on battery to slide it out just far enough to access positive terminal.

B. Disconnect positive lead from battery pak.

C. Slide battery completely out and disconnect negative lead at back of battery pak.

D. Remove battery pak.

E. Repeat procedure to remove remaining battery pak.

NOTE: When replacing battery pak, keep the battery leads flat on top of the battery while sliding it back into the instrument. Also, before closing the Lower Front Panel, ensure that the Control PFC Assembly is tucked back into the instrument to prevent it from being pinched between the lower front panel and front case.

4-26. Rear Panel Assembly Removal.

After completing Rear Case Removal proceed as follows:

A. Remove four screws with washers (43), (59) and one screw (43).

B. Disconnect wire harness from P15 and speaker from P18.

4-27. Main PCB Assembly Removal.

After completing Rear Panel Assembly Removal proceed as follows:

A. Disconnect battery pak (2) at P17A and P17B on the Power Supply PCB Assembly (A2).

B. Disconnect J13 from the Main PCB Assembly (A1).

C. Gently rock the Main PCB Assembly back and forth until J10 and J11 have cleared their respective connectors. Lay the Main PCB Assembly down along side the Defibrillator.

D. Disconnect J12 and J21 from the Main PCB.

4-28. Power Supply PCB Assembly Removal.

After completing Main PCB Assembly Removal proceed as follows:

A. Disconnect P8 from the Power Supply PCB Assembly (A2).

B. Release the six PCB retainer clips (36) and lift the Power Supply PCB from the Chassis.

4-29. Logic PCB Assembly Removal.

After completing Power Supply PCB Assembly Removal proceed as follows:

A. Disconnect P9 and P2 from the Logic PCB Assembly (A8).

B. Release three PCB retainer clips (35).

C. Remove Logic PCB from Chassis.

NOTE: When replacing Logic PCB in Chassis, slide front edge of Logic PCB into conduit cover PCB retainers before positioning above three PCB retainer clips.

4-30. Paddle Removal.

After completing Logic PCB Assembly and Battery Pak Removal proceed as follows:

NOTE: The procedures for removal of the Apex or Sternum paddles are nearly identical so references to either Apex or Sternum paddles have not been included.

A. Remove four screws (46) that attach the conduit cover (13) to the conduit (8).

B. Loosen two screws (43) that support the Module B Connector (9).

C. Raise the left side of conduit cover until it clears the coil cord rollers (38), and move it to the left away from the Chassis.

D. Disconnect the paddle connections on the lower front of the Chassis.

E. Pull the coil cord strain relief out of strain relief boss.

F. Pull the coil cord out through the Front Panel opening.

4-31. PACING CASSETTE DISASSEMBLY PROCEDURE

The following procedures provide a logical sequence for removing the major components of the LIFEPAK 8 Pacing Cassette. Special notes are provided as required. Refer to Figure 5-37 drawing and parts list. Parenthetical numbers in the disassembly procedure refer to item numbers in the parts list.

4-32. Pacing Cassette Case Separation.

A. Force a flex circuit removal tool under the edge of the Control Label next to the RATE knob (8). Pry it up until the edge is high enough to hold on to.

NOTE: The Pacing Cassette Control Label (802946) cannot be reused. Replace the Control Label when reassembling the instrument.

B. Remove the five screws (16) from the Front Housing (3) that were previously hidden by the Control Label. Remove four screws with washers (15),(27) from the Rear Cover (2). The Case may then be separated.

4-33. Pacing Cassette PFC Assembly Removal.

After completing Pacing Cassette Case Separation, proceed as follows:

A. Remove the RATE and CURRENT knobs (8), (7).

1. Turn the RATE and CURRENT knobs fully counterclockwise. This will align the set screws (21) with access holes.
2. Loosen the set screws and pull the knobs off from the front of the instrument.

B. Remove the nuts from the control mounting posts.

C. Remove three long screws (19) and two short screws (18) that hold the Pacing Cassette PFC Assembly (A2) to the Front Housing (3).

D. Loosen the two screws (16) that hold J2 to the Front Housing.

E. Release the six circuit board retainers that hold the connector circuit board.

F. Disconnect P1 from J1.

G. Lift and rotate the Pacing Cassette PFC Assembly (A2) so the Switch Display PCB Assembly shield (22) is exposed. Remove the shield.

H. Remove three screws and washers(17),(24)from the Switch Display PCB Assembly (A1).

I. Lift the Pacing Cassette PFC Assembly and the Switch Display PCB Assembly out of the instrument and separate them with the flex circuit removal tool.

4-34. INSPECTION TECHNIQUES

A. Exterior Visual Inspections.

1. Visually inspect the entire LIFEPAK 8 for wear, maintenance damage, corrosion, deterioration, and damage resulting from extreme temperature, or droppage.

B. Interior Visual Inspection.

1. Use a minimum of five-power magnification to check components, wiring, solder joints and printed circuit conductor patterns.

2. Inspect for the following conditions:

   a. Check all connectors for loose, bent or corroded contact pins.

   b. Check wires, harnesses and cables for signs of wear or deterioration.

   c. Inspect sleeving and tubing for proper installation or evidence of damage.

   d. Inspect components and their leads for security of mounting, deterioration or leakage.

   e. Check terminals and connections for proper installation, faulty soldering, loss or wear.

   f. Inspect printed circuit board surfaces for charring, cracking or brittleness.

NOTE: Some degree of discoloration to the PCB surface may be expected due to continued exposure to operating temperatures of some of the components.

   g. Check identification nameplate and other decals for legibility.

   h. Inspect chassis, covers and brackets for warping, bending, surface damage or missing hardware.

   i. Check all screws and nuts for tightness or signs of stripped or cross-threaded threads.

   j. Check for damaged traces on PCBs. Look for lifted conductors and inspect for breaks, scratches, nicks or pinholes.

   k. Check for any other form of mechanical damage which may indicate a failure.

4-35. CLEANING TECHNIQUES

This section contains instructions for periodic cleaning of the LIFEPAK 8 as a preventive maintenance measure and specific cleaning procedures to be conducted after disassembly and/or repair.

A. General.

1. Parts having identical cleaning procedures are grouped under common headings. No special tools are required.

2. Refer to paragraph 4-3 for a list of cleaning materials.

B. Interior Cleaning.

WARNING

VENTILATE WORK AREA THOROUGHLY WHEN USING SOLVENTS. OBSERVE MANUFACTURERS' WARNING ON SOLVENT CONTAINERS WITH REGARD TO PERSONNEL SAFETY AND EMERGENCY FIRST AID. BE SURE FIRST AID EQUIPMENT IS AVAILABLE BEFORE USING CHEMICALS.

WARNING

OBSERVE SHOP SAFETY AND FIRE PRECAUTIONS. VENTILATE ALL WORK AREAS WHERE SOLVENTS ARE USED. STORE SOLVENTS AND SOLVENT SOAKED RAGS IN APPROVED CONTAINERS. REFER TO MANUFACTURERS' INSTRUCTIONS ON CONTAINERS FOR RECOMMENDED FIRE FIGHTING PROCEDURES AND NOTE THAT FIRE FIGHTING EQUIPMENT IS AVAILABLE.

1. Magnetics.

   Clean transformers and inductors with a dry nonmetallic soft-bristle brush.

CAUTION

DO NOT USE SOLVENTS TO CLEAN TRANSFORMERS OR INDUCTORS. THE CHEMICAL ACTION OF SOLVENTS MAY REMOVE THE VARNISH FROM THE WIRE COILS, RENDERING THE COMPONENT USELESS. THE SOLVENT ALSO NEUTRALIZES THE ADHESIVE OF THE COVER TAPE, RESULTING IN EVENTUAL TAPE SEPARATION FROM THE WINDINGS.

2. Printed Circuit Boards.

CAUTION

SOME PRINTED CIRCUIT BOARD ASSEMBLIES IN THE LP 8 CONTAIN STATIC SENSITIVE DEVICES. USE STATIC SENSITIVE DEVICES (SSDs) SPECIAL HANDLING PROCEDURES.

   a. Clean assembled parts with a vacuum cleaner or low pressure compressed air (60 psi).

   b. Prior to soldering, clean surfaces with nonmetallic, soft-bristle brush dipped in solvent.

   c. Dry with low pressure compressed air.

CAUTION

TAKE CARE WHEN CLEANING PRINTED CIRCUIT BOARDS THAT WIRES OR COMPONENT LEADS ARE NOT BENT BACK AND FORTH IN SUCH A MANNER AS TO WEAKEN THEM AND CAUSE THEM TO EVENTUALLY BREAK.

d. Remove excess solder from solder joints and chassis components after repairs.

3. Metallic and Plastic Parts.

   a. Brush all surfaces and parts with a nonmetallic, soft-bristle brush.

   b. Wipe metal surfaces with soft, nonabrasive cloth dampened with isopropyl alcohol.

CAUTION

DO NOT WIPE OVER SURFACES OF NAMEPLATES OR LABELS WITH ABRASIVE CLEANERS OR MATERIALS, AS THIS WILL EVENTUALLY WEAR AWAY THE NAMEPLATE INFORMATION.

CAUTION

DO NOT USE SOLVENTS TO CLEAN PLASTIC PARTS.

   c. Dry clean surfaces with clean cloth.

   d. Wipe surfaces of nameplates and labels with clean dry cloth.

C. Exterior Cleaning Procedures.

1. Case and Display. Use soap and water to clean external covers and line cord. Do not use alcohol, solvents, or cleaning solutions. These cleaning agents may damage the surfaces of the instrument.

4-36. REPAIR TECHNIQUES

Instructions contained in this section provide the information necessary to return the LIFEPAK 8 and its subassemblies to serviceable condition.

A. General

Conduct the necessary level of disassembly and inspection to identify all areas requiring repair.

1. Before removing an assembly for repair or replacement, label each lead or draw a sketch showing the location of cables and wires.

2. Refer to paragraph 4-4 for a list of repair materials.

B. Repair Procedures.

NOTE: Repair procedures contained here are recommended only as an alternative to complete assembly replacement.

1. Do not attempt to straighten bent connector pins or chassis frame members unless the bending or warpage is slight. Parts damaged beyond this level should be replaced.

2. PCB installed components are normally nonrepairable and must be replaced when found faulty.

3. PCB Component Replacement.

   a. Replace all electronic components not meeting the requirements outlined in Testing and Calibration.

   b. Replace electrical wire as required with wire of same length, color and gauge as that being replaced. Install the terminations identified on the applicable wire list.

   c. Remove excess solder from pad by wicking or vacuuming.

   d. Grasp the component with pliers and use a 60 watt soldering iron to remove components from circuit board, being careful not to lift solder pads.

CAUTION

WHEN INSTALLING COMPONENTS ON PRINTED CIRCUIT BOARD, REFER TO TRANSISTOR INDEXING, TAB POSITIONS, DIODE MARKINGS, CAPACITOR POLARITIES ILLUSTRATED IN THE SECTION 5 COMPONENT LAYOUTS.

   e. Bend new component leads to fit mounting solder pads on PCB and trim leads to desired length. Be sure component is oriented in the proper polarity position and install it on the board, then solder in place.

NOTE: On heat sink mounted components, verify the isolation between the component tab and the heat sink with an ohmmeter before soldering the leads.

CAUTION

USE A HEAT SINK WHEN SOLDERING DIODES AND TRANSISTORS, AND USE A MINIMUM OF HEAT WHEN SOLDERING COMPONENTS TO PRINTED CIRCUIT BOARDS.

   f. Clean residual flux from soldered areas with an acid brush and isopropyl alcohol then dry with compressed air.

   g. Test before reassembly.

4. Repair Of Damaged Or Defective Trace. A damaged trace may be a complete break or scratches, nicks, or pinholes which reduce the cross-sectional area of the conductor beyond original design specifications (see Figure 4-3).

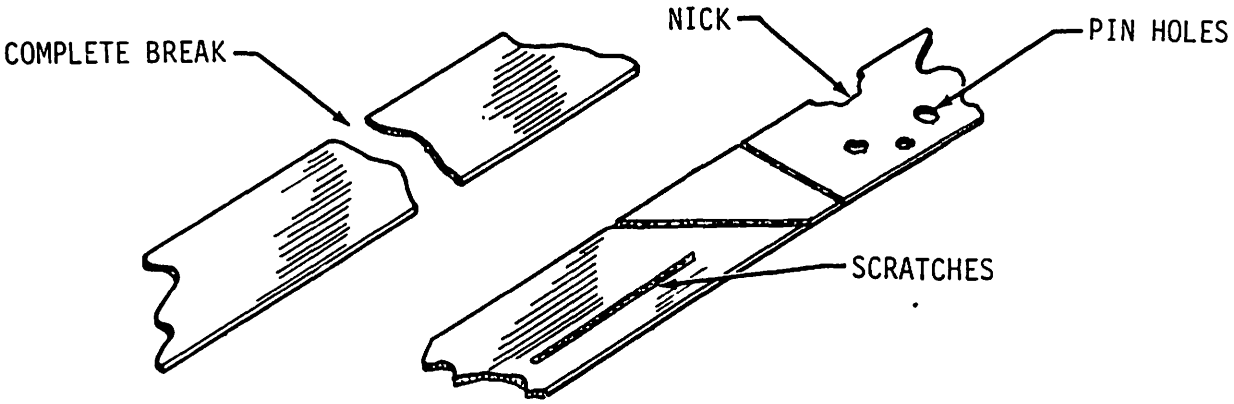

COMPLETE BREAK
NICK
PIN HOLES
SCRATCHES

FIGURE 4-3. TYPICAL PRINTED WIRING DAMAGE

NOTE: Repair should be limited to two repairs per board. The damaged section of the conductor should not exceed five times the conductor width.

a. Clean both sides of break in conductor, at least 1/4 inch on each side, with a rubber eraser, then clean with an acid brush and isopropyl alcohol.

b. Cut a piece of 22 or 24 gauge solid, tinned copper wire a minimum of 1/4 inch longer than the break. The wire may optionally be flattened by placing it between smooth metal plates and pressing with a bench vise.

c. Hold the wire on the centerline of the conductor, across the break, and solder in place (see Figure 4-4).

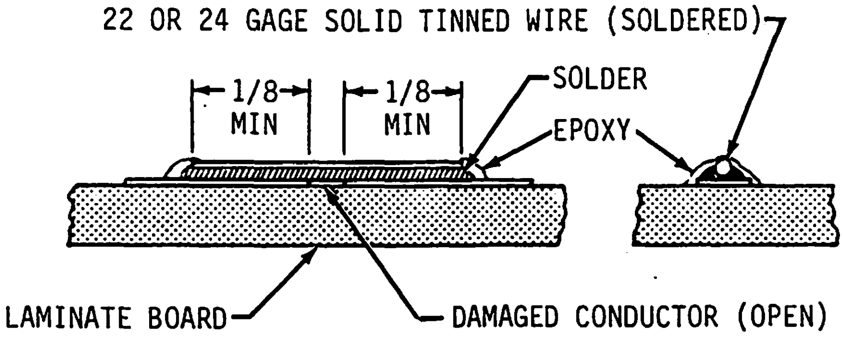

22 OR 24 GAGE SOLID TINNED WIRE (SOLDERED)
1/8 MIN
1/8 MIN
SOLDER
EPOXY
LAMINATE BOARD
DAMAGED CONDUCTOR (OPEN)

FIGURE 4-4. REPAIRING DAMAGED CONDUCTOR

d. Remove solder flux with cloth dampened with isopropyl alcohol and dry with compressed air.

e. Flow a small amount of 5-minute epoxy cement over the entire repair and allow to dry at room temperature for 15 minutes.

5. Repairing Lifted Conductors. A lifted conductor is present when a portion of the conductor is separated from the PC board surface, but is not broken (see Figure 4-5).

   a. Rinse area to be repaired with isopropyl alcohol and dry with compressed air. Be sure that underside of lifted conductor is clean and remove any obstacles which prevent the lifted conductor from making total contact with the substrate surface.

   b. Apply 5-minute epoxy to surface of lifted conductor and to a distance of at least 1/8 inch in all directions from the damaged area.

   c. Dry at room temperature for one hour.

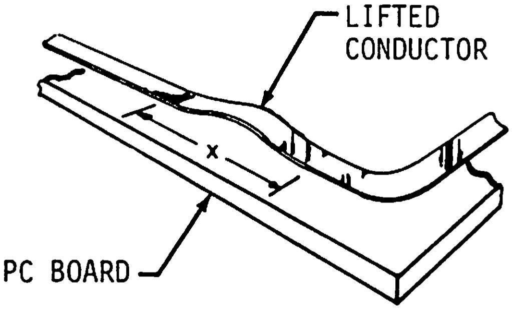


FIGURE 4-5. TYPICAL LIFTED CONDUCTOR

NOTE: The length of the lifted conductor which is repairable shall not exceed one half the length of the conductor path between two terminal areas or one half inch, whichever is smaller. See dimension X in Figure 4-5.

6. Cover and Case Repair/Replacement. Cover and case repair should be attempted only if the damage is minor; otherwise the damaged part should be replaced. Minor damage is damage that does not effect the structural integrity of the case.

NOTE: Do not attempt to straighten severe bends or to repair severely cracked case halves. Should any damage of this nature be present, replace defective part.

   a. Replacement.

      1. Replace all cross- or strip-threaded items.

      2. If restoration does not return damaged parts to a serviceable condition, then the damaged parts should be replaced.

b. Repair.

1. Remove all traces of grease, dirt or other foreign matter from the damaged area with isopropyl alcohol.

2. Apply trichloroethylene along the line where the pieces meet with a cotton swab.

3. If the joint being repaired is closed, such as a crack, clamping is not necessary; however, if a separate piece is being rejoined that will not hold itself together then clamping is necessary. Allow either joint to set for 24 hours before reassembly.

4. Should surfaces be nicked, scratched or burred, the damaged area can be refinished as follows:

5. Using crocus cloth, work burrs or nicks down to the level of the surrounding area.

6. Brush apply a coat of matching color model paint to the repaired surface.

SECTION 5
ASSEMBLIES, PARTS LISTS, SCHEMATICS

5-1. OVERVIEW

This section provides exploded view drawings of mechanical assemblies, parts lists, component layouts, and schematics for electronic PCB assemblies. Table 5-1 (Monitor) and Table 5-2 (Defibrillator) list the assemblies and their corresponding figure numbers. For ICs marked with a star (✱) on the following schematics, additional reference information can be found in Section 6.

5-2. PARTS LISTS

This paragraph explain the five column headings used in all parts lists in Section 5.

A. **FIG-ITEM** This column contains the figure number of the illustrated assembly followed by the reference designators or the assigned item numbers of parts used in that assembly. Reference designators are listed alphanumerically; item numbers are listed numerically.

B. **PART NUMBER** Physio-Control Corporation part number is listed in this column. Part ordering information is provided in paragraph 5-3.

C. **DESCRIPTION** This column contains descriptive information. For a part that is used more than once, subsequent listings refer back to the initial listing with a "Same as ___" citation. This citation may also list a component value when necessary. Static Sensitive Devices (SSDs) are identified in this column by this symbol: ⚠ ATTENTION Special Handling of PCB assemblies containing SSDs is required (see document 2003-027).

D. **USE CODE** This column contains letter codes which indicate configuration differences. configurations and their corresponding alphabetical codes are listed at the beginning of each parts list. Subsequent use of the letter codes indicates which parts are used in each configuration. A blank in this column indicates that the part is used in all configurations.

E. **QTY** The final column specifies the total quantity used for each part number listed. The abbreviation REF indicates a major assembly or subassembly.

5-3. PARTS ORDERING

Some parts may be purchased locally. When ordering from Physio-Control Corporation, give the instrument model and serial number. Include part number, reference designation, and description. Different parts may be substituted by Physio-Control to reflect modifications and improvements of instrument circuitry.

Recorder parts may be ordered from Physio-Control Corporation as available, or from MFE or GSI Corporations.

MFE
Instruments Division
Keewaydin Drive
Salem, New Hampshire 03079
(603-893-1921)
TWX: 710-366-1887
Telex: 94-7477

GSI
500 Arsenal Street
Watertown, Massachusetts 02270
(617-924-1010)
Telex: 4430105

TABLE 5-1

LP 8 MONITOR ASSEMBLIES, PARTS LISTS, SCHEMATICS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
802800	MONITOR FINAL ASSEMBLY	5-1
802803	UPPER FRONT PANEL ASSEMBLY	5-2
802804	LOWER FRONT PANEL ASSEMBLY	5-3
802801	GENERIC MONITOR ASSEMBLY	5-4
802801	CRT ASSEMBLY	5-5
802808	REAR PANEL ASSEMBLY	5-6
802854	RECORDER ASSEMBLY	5-7A
802853	RECORDER ASSEMBLY	5-7B
802801	MONITOR INTERCONNECT DIAGRAM	5-8
802821	CHARGER PCB ASSEMBLY	5-9
802815	POWER SUPPLY PCB ASSEMBLY	5-10
802833	ECG PCB ASSEMBLY	5-11
802827	CONTROL PCB ASSEMBLY	5-12
802835	GATEWAY PCB ASSEMBLY	5-13
802831	CRT PCB ASSEMBLY	5-14
802813	ANODE SUPPLY PCB ASSEMBLY	5-15
802819	RECORDER PFC ASSEMBLY	5-16A
802811	RECORDER PFC ASSEMBLY	5-16B
802845	UPPER SWITCH MODULE PCB ASSEMBLY	5-17
802844	LOWER SWITCH MODULE PCB ASSEMBLY	5-18
802829	REAR PANEL PCB ASSEMBLY	5-19
802823	MAIN PFC ASSEMBLY	5-20

TABLE 5-2

LP 8 DEFIBRILLATOR ASSEMBLIES, PARTS LISTS, SCHEMATICS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
802700	DEFIBRILLATOR FINAL ASSEMBLY	5-21
802707	UPPER FRONT PANEL ASSEMBLY	5-22
802702	LOWER FRONT PANEL ASSEMBLY	5-23
802701	GENERIC DEFIBRILLATOR ASSEMBLY	5-24
802901	GENERIC APEX AND STERNUM PADDLE ASSEMBLIES	5-25
802703	REAR PANEL ASSEMBLY	5-26
802701	DEFIBRILLATOR INTERCONNECT DIAGRAM	5-27
802719	POWER SUPPLY PCB ASSEMBLY	5-28
802715	MAIN PCB ASSEMBLY	5-29
802725	LOGIC PCB ASSEMBLY	5-30
802717	OPTICAL INTERFACE PCB ASSEMBLY	5-31
802713	TEST LOAD PCB ASSEMBLY	5-32
802711	UPPER SWITCH MODULE PCB ASSEMBLY	5-33
802709	LOWER SWITCH MODULE PCB ASSEMBLY	5-34
803569	CASSETTE INTERFACE PCB ASSEMBLY	5-35
802721	CONTROL PFC ASSEMBLY	5-36

TABLE 5-3

LP 8 ACCESSORY CASSETTES ASSEMBLIES, PARTS LISTS, SCHEMATICS

DRAWING NO.	NOMENCLATURE	FIGURE NO.
802904	PACING CASSETTE FINAL ASSEMBLY	5-37
802904	PACING CASSETTE INTERCONNECT DIAGRAM	5-38
802913	PACING CASSETTE SWITCH DISPLAY PCB ASSEMBLY	5-39
802911	PACING CASSETTE PFC ASSEMBLY	5-40
802903	DEFIBRILLATOR CASSETTE FINAL ASSEMBLY	5-41
802903	DEFIBRILLATOR CASSETTE WIRING DIAGRAM	5-42

TABLE 5-4

LP 8 MONITOR ASSEMBLY LOCATION CODES

DRAWING NO.	NOMENCLATURE	LOCATION CODE
802823	MAIN PFC ASSEMBLY	A1
802815	POWER SUPPLY PCB ASSEMBLY	A2
802821	CHARGER PCB ASSEMBLY	A3
802833	ECG PCB ASSEMBLY	A4
802835	GATEWAY PCB ASSEMBLY	A5
802827	CONTROL PCB ASSEMBLY	A6
802831	CRT PCB ASSEMBLY	A7
802813	ANODE SUPPLY PCB ASSEMBLY	A8
802819	RECORDER PFC ASSEMBLY	A9
802811	RECORDER PFC ASSEMBLY	A9
802829	REAR PANEL PCB ASSEMBLY	A10
802844	LOWER SWITCH MODULE PCB ASSEMBLY	A11
802845	UPPER SWITCH MODULE PCB ASSEMBLY	A12
802854	RECORDER ASSEMBLY	A13
802853	RECORDER ASSEMBLY	A13
---	CHASSIS/HARNESS	A14

TABLE 5-5

LP 8 DEFIBRILLATOR ASSEMBLY LOCATION CODES

DRAWING NO.	NOMENCLATURE	LOCATION CODE
802715	MAIN PCB ASSEMBLY	A1
802719	POWER SUPPLY PCB ASSEMBLY	A2
800240	TRANSFER RELAY ASSEMBLY	A3
802901	APEX PADDLE ASSEMBLY	A4
802901	STERNUM PADDLE ASSEMBLY	A5
802711	UPPER SWITCH MODULE PCB ASSEMBLY	A6
802709	LOWER SWITCH MODULE PCB ASSEMBLY	A7
802725	LOGIC PCB ASSEMBLY	A8
803569	CASSETTE INTERFACE PCB ASSEMBLY	A9
802713	TEST LOAD PCB ASSEMBLY	A10
802717	OPTICAL INTERFACE PCB ASSEMBLY	A11
802721	CONTROL PFC ASSEMBLY	A12
---	CHASSIS/HARNESS	A13

TABLE 5-6

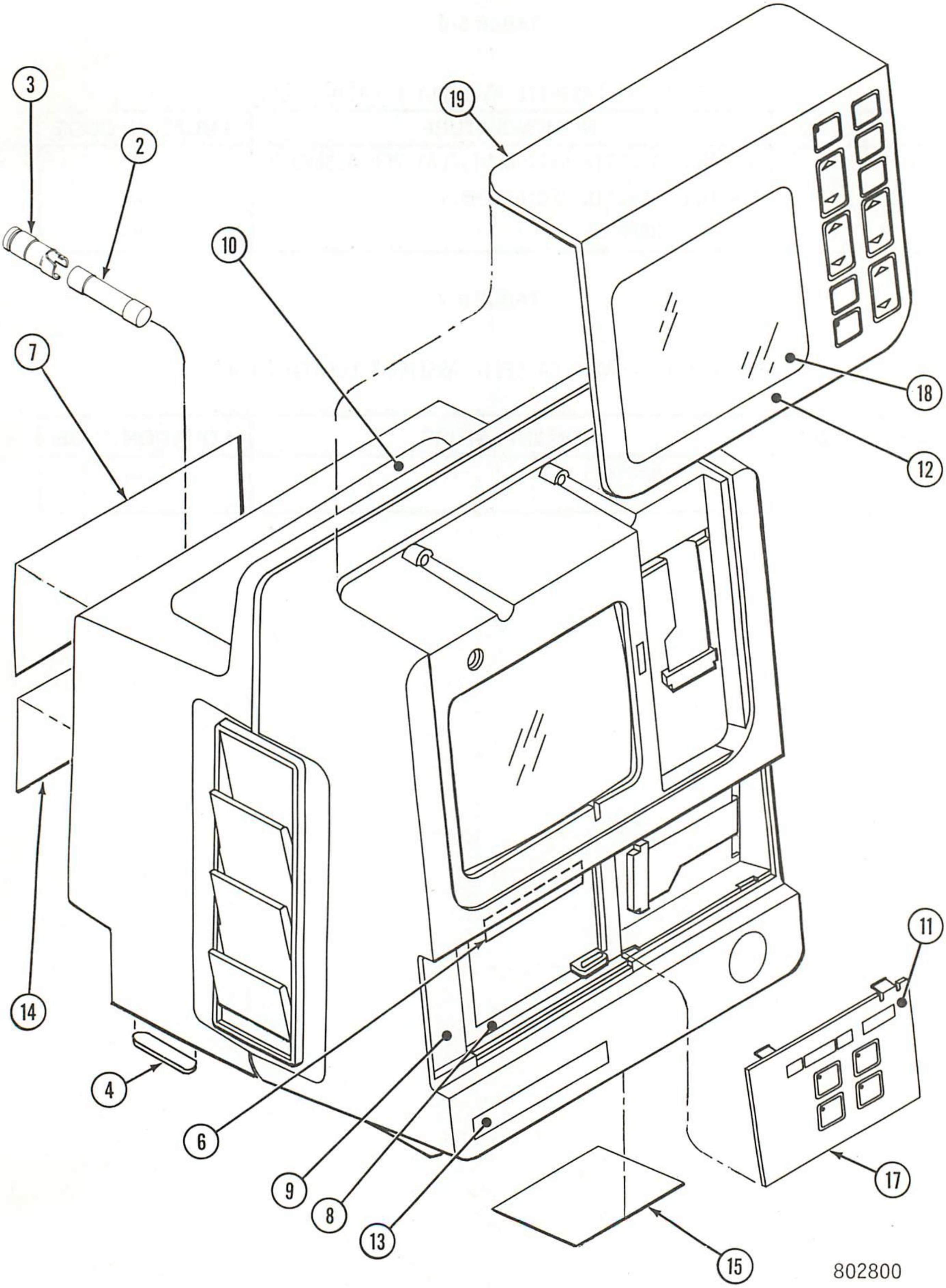
LP 8 PACING CASSETTE ASSEMBLY LOCATION CODES

DRAWING NO.	NOMENCLATURE	LOCATION CODE
802913	PACING CASSETTE SWITCH DISPLAY PCB ASSEMBLY	A1
802911	PACING CASSETTE PFC ASSEMBLY	A2
---	CHASSIS/HARNESS	A3

TABLE 5-7

LP 8 DEFIBRILLATOR CASSETTE ASSEMBLY LOCATION CODES

DRAWING NO.	NOMENCLATURE	LOCATION CODE
---	CHASSIS/HARNESS	A1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802800

FIGURE 5-1. MONITOR FINAL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1				
	802800-14	Monitor, LP 8, 100/120V, 60Hz, English	A	REF
	802800-15	Monitor, LP 8, 220/240V, 50Hz, English	B	REF
	802800-16	Monitor, LP 8, 100/120V, 60Hz, French	C	REF
	802800-17	Monitor, LP 8, 220/240V, 50Hz, French, International	D	REF
	802800-18	Monitor, LP 8, 220/240V, 50Hz, German	E	REF
	802800-19	Monitor, LP 8, 100/120V, 60Hz, Spanish	F	REF
	802800-20	Monitor, LP 8, 220/240V, 60Hz, Spanish	G	REF
	802800-21	Monitor, LP 8, 100/120V, 50Hz, English	H	REF
	802800-22	Monitor, LP 8, 220/240V, 60Hz, English	I	REF
	802800-23	Monitor, LP 8, 220/240V, 50Hz, Spanish	J	REF
	802800-24	Monitor, LP 8, 120V, 60Hz, English, CSA	K	REF
	802800-25	Monitor, LP 8, 120V, 60Hz, French, CSA	L	REF
	802800-26	Monitor, LP 8, 120V, 60Hz, English, UL	M	REF
	802801-03	Monitor, LP 8, Generic		1
2	200281-022	. FUSE, Fast Blow, 2A/250V, .125 L X .250 D	A-D,F-M	2
	200603-014	. FUSE, Fast Blow, 2A/250V	E	2
3	201203-014	. FUSEHOLDER, Grey, 3 Ag	A-D,F-M	2
	201203-015	. FUSEHOLDER, Black, 5 X 20 mm	E	2
4	802885-00	. FOOT, Mounting, LP 8		4
5	200795-00	. LABEL, Approval, CLA (Not Shown)	A,M	1
6	803652-00	. LABEL, Caution, ECG Paper, English	A,B,H,I,K	1
	803652-01	. LABEL, Caution, ECG Paper, French	C,D,L	1
	803652-02	. LABEL, Caution, ECG Paper, German	E	1
	803652-03	. LABEL, Caution, ECG Paper, Spanish	F,G	1
7	802848-00	. LABEL, Caution, English	A,B,H,I,K	1
	802848-01	. LABEL, Caution, French	C,D,L	1
	802848-02	. LABEL, Caution, German	E	1
	802848-03	. LABEL, Caution, Spanish	F,G,J	1
8	801275-00	. LABEL, Caution, Hot Stylus, English	A,B,H,I,K	1
	801275-04	. LABEL, Caution, Hot Stylus, French	C,D,L	1
	801275-05	. LABEL, Caution, Hot Stylus, German	E	1
	801275-06	. LABEL, Caution, Hot Stylus, Spanish	F,G,J	1
9	802866-00	. LABEL, Front, Lower Left		1
10	802867-00	. LABEL, Instruction, English, 120V	A	1
	802867-01	. LABEL, Instruction, French, 120V	C,D	1
	802867-03	. LABEL, Instruction, Spanish, 120V	F,G,J	1
	802867-04	. LABEL, Instruction, English, 120V	B,H,I	1
	802867-05	. LABEL, Instruction, English, CSA	K	1
	802867-06	. LABEL, Instruction, French, CSA	L	1
	802867-07	. LABEL, Instruction, German, 240V	E	1
11	802862-00	. LABEL, Lower Front, English	A,B,I	1
	802862-01	. LABEL, Lower Front, French	C,D,L	1
	802862-02	. LABEL, Lower Front, German	E	1
	802862-03	. LABEL, Lower Front, Spanish	F,G,J	1
12	802863-01	. LABEL, Panel, Upper Front		1
13	802768-00	. LABEL, Product Name, English	A,B,H,I,K	1
	802768-02	. LABEL, Product Name, French	C,D,L	1
	802768-04	. LABEL, Product Name, German	E	1
	802768-06	. LABEL, Product Name, Spanish	F,G,J	1
14	802865-01	. LABEL, Rear Panel, French	C,D,L	1
	802865-03	. LABEL, Rear Panel, Spanish	F,G,J	1
	802865-04	. LABEL, Rear Panel, English	B,I	1
	802865-05	. LABEL, Rear Panel, English	A,H,K	1
	802865-06	. LABEL, Rear Panel, German	E	1
15	802864-07	. LABEL, Serial Number, English, Monitor	B,H,I	1
	802864-01	. LABEL, Serial Number, French	C,D	1
	802864-02	. LABEL, Serial Number, German	E	1
	802864-03	. LABEL, Serial Number, Spanish	F,G,J	1
	802864-05	. LABEL, Serial Number, English, CSA	K	1
	802864-06	. LABEL, Serial Number, French, CSA	L	1
16	801517-04	. LABEL, U.L. (Not Shown)	M	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-1 17	802804-05	. PANEL ASSEMBLY, Lower Front, English	A,B,H,I, K	1
	802804-06	. PANEL ASSEMBLY, Lower Front, French	C,D,L	1
	802804-07	. PANEL ASSEMBLY, Lower Front, German	E	1
	802804-08	. PANEL ASSEMBLY, Lower Front, Spanish	F,G,J	1
18	802875-01	. PANEL, CRT		1
19	802803-04	. PANEL ASSEMBLY, Upper Front, English	A,B,H,I, K	1
	802803-05	. PANEL ASSEMBLY, Upper Front, French	C,D,L	1
	802803-06	. PANEL ASSEMBLY, Upper Front, German	E	1
	802803-07	. PANEL ASSEMBLY, Upper Front, Spanish	F,G,J	1

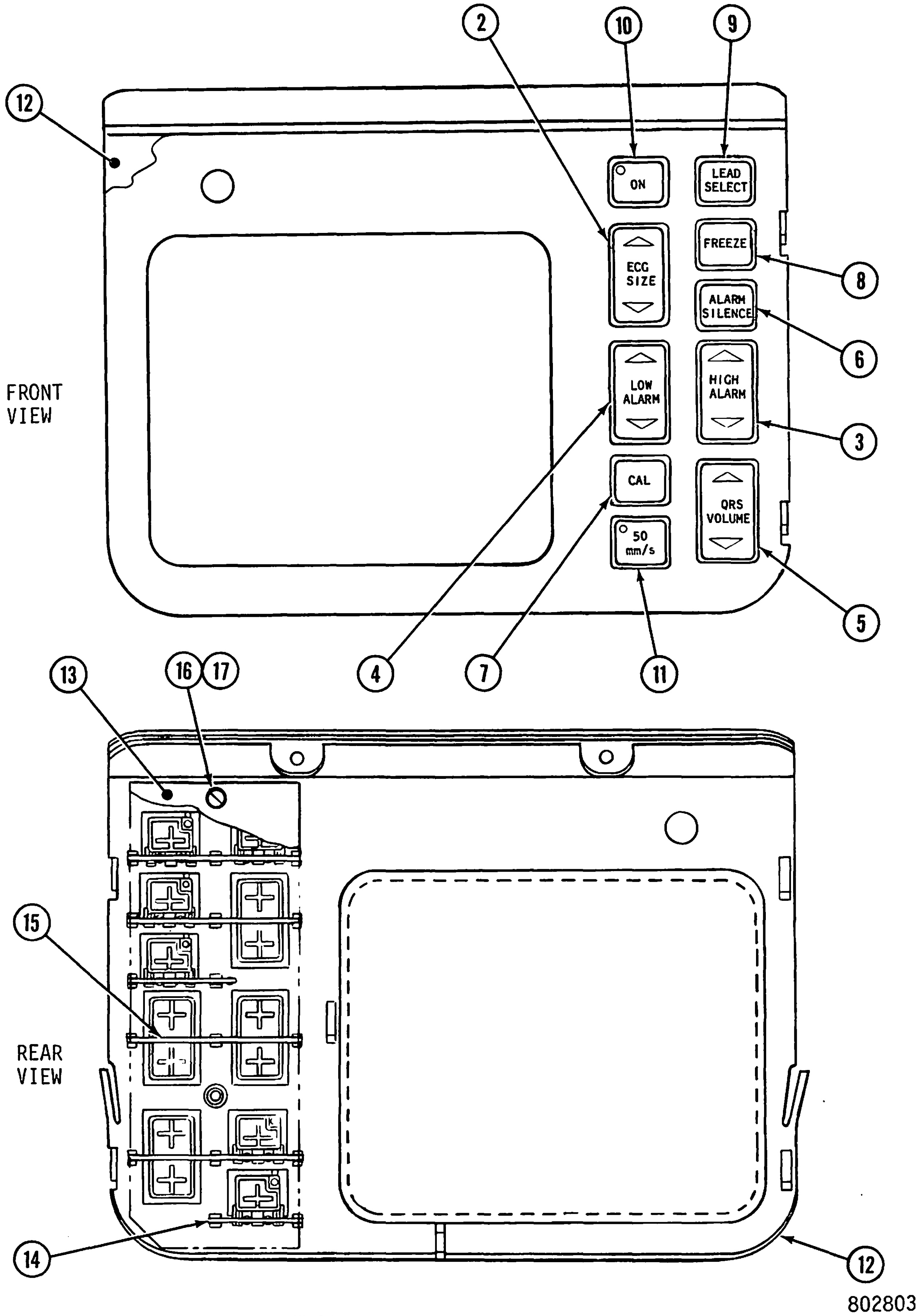
2
10
9
12
ON
LEAD SELECT
ECG SIZE
FREEZE
8
ALARM SILENCE
6
FRONT VIEW
LOW ALARM
HIGH ALARM
3
CAL
QRS VOLUME
50 mm/s
5
13
16
17
4
7
11
15
REAR VIEW
14
12
802803

FIGURE 5-2. UPPER FRONT PANEL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-2				
	802803-04	UPPER FRONT PANEL ASSEMBLY, Monitor, English	A	REF
	802803-05	UPPER FRONT PANEL ASSEMBLY, Monitor, French	B	REF
	802803-06	UPPER FRONT PANEL ASSEMBLY, Monitor, German	C	REF
	802803-07	UPPER FRONT PANEL ASSEMBLY, Monitor, Spanish	D	REF
2	802857-16	. KEY, Dual, ECG SIZE	A	1
	802857-20	. KEY, Dual, ECG GAIN	B	1
	802857-24	. KEY, Dual, EKG AMPL	C	1
	802857-28	. KEY, Dual, AMP ECG	D	1
3	802857-18	. KEY, Dual, HIGH ALARM	A	1
	802857-22	. KEY, Dual, ALARME TACHY	B	1
	802857-26	. KEY, Dual, OBERER ALARM	C	1
	802857-30	. KEY, Dual, ALARMA ALTO	D	1
4	802857-17	. KEY, Dual, LOW ALARM	A	1
	802857-21	. KEY, Dual, ALARME BRADY	B	1
	802857-25	. KEY, Dual, UNTERER ALARM	C	1
	802857-29	. KEY, Dual, ALARMA BAJO	D	1
5	802857-19	. KEY, Dual, QRS VOLUME	A	1
	802857-23	. KEY, Dual, VOLUME QRS	B	1
	802857-27	. KEY, Dual, QRS LAUTST	C	1
	802857-31	. KEY, Dual, VOL QRS	D	1
6	802884-01	. KEY, Single, ALARM SILENCE	A	1
	802884-07	. KEY, Single, Alarm Silence Symbol	B-D	1
7	802884-02	. KEY, Single, CAL		1
8	802884-05	. KEY, Single, FREEZE	A	1
	802884-08	. KEY, Single, Freeze Symbol	B-D	1
9	802884-00	. KEY, Single, LEAD SELECT	A	1
	802884-06	. KEY, Single, DERIV	B	1
	802884-09	. KEY, Single, SELEC DERIV	D	1
	802884-10	. KEY, Single, EKG ABLTG	C	1
10	802883-00	. KEY, Single, W/Lens, ON	A	1
	802883-11	. KEY, Single, W/Lens, I/O	B-D	1
11	802883-01	. KEY, Single, W/Lens, 50mm/s		1
12	802851-01	. PANEL, Upper Front, W/Inserts		1
13	802845-01	. PCB ASSEMBLY, Upper Switch Module (See Figure 5-17)		1
14	802776-03	. PIN, Hinge, 1.100 L		2
15	802776-04	. PIN, Hinge, 2.000 L		4
16	200476-762	. SCREW, Pan Head, 4-40 X .437 L		2
17	90-04008	. WASHER, Flat, #4 X .312 OD/.020T		2

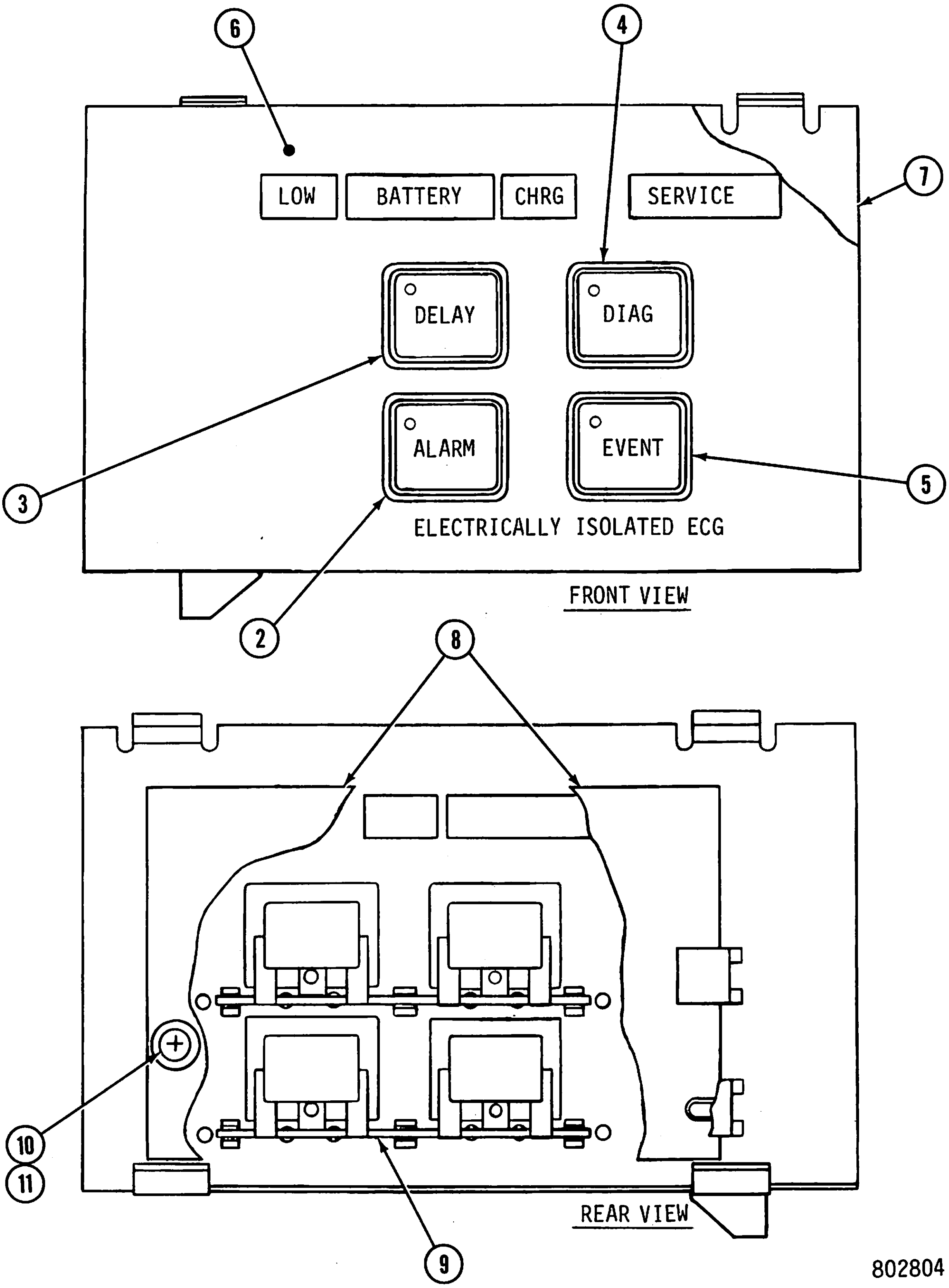
6
4
LOW
BATTERY
CHRG
SERVICE
7
DELAY
DIAG
ALARM
EVENT
3
5
ELECTRICALLY ISOLATED ECG
FRONT VIEW
2
8
10
11
REAR VIEW
9
802804

FIGURE 5-3. LOWER FRONT PANEL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-3				
	802804-05	LOWER FRONT PANEL ASSEMBLY, Monitor, English	A	REF
	802804-06	LOWER FRONT PANEL ASSEMBLY, Monitor, French	B	REF
	802804-07	LOWER FRONT PANEL ASSEMBLY, Monitor, German	C	REF
	802804-08	LOWER FRONT PANEL ASSEMBLY, Monitor, Spanish	D	REF
	802804-09	LOWER FRONT PANEL ASSEMBLY, Monitor, English, AC Only	E	REF
2	802883-04	. KEY, Single, W/Lens, ALARM	A,C,E	1
	802883-14	. KEY, Single, W/Lens, ALARME	B	1
	802883-16	. KEY, Single, W/Lens, ALARMA	D	1
3	802883-02	. KEY, Single, W/Lens, DELAY	A,E	1
	802883-12	. KEY, Single, W/Lens, RETARD	B,D	1
	802883-22	. KEY, Single, W/Lens, VERZOG	C	1
4	802883-03	. KEY, Single, W/Lens, DIAG		1
5	802883-05	. KEY, Single, W/Lens, EVENT	A,E	1
	802883-15	. KEY, Single, W/Lens, MARQ	B	1
	802883-25	. KEY, Single, W/Lens, EREIG	C	1
	802883-17	. KEY, Single, W/Lens, SUCESO	D	1
6	802862-00	. LABEL, Graphic, Lower	A	1
	802862-01	. LABEL, Graphic, Lower	B	1
	802862-02	. LABEL, Graphic, Lower	C	1
	802862-03	. LABEL, Graphic, Lower	D	1
	802862-04	. LABEL, Graphic, Lower	E	1
7	802852-01	. PANEL, Lower, Front, W/Inserts		1
8	802844-03	. PCB ASSEMBLY, Lower Switch Module (See Figure 5-18)		1
9	802776-04	. PIN, Hinge		2
10	200476-761	. SCREW, Pan Head, 4-40 X .312 L		1
11	90-04008	. WASHER, Flat, #4 X .312 OD/.020T		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
	802801-00	MONITOR, Generic, Lifepak 8	A	REF
	802801-01	MONITOR, Generic, Lifepak 8	B	REF
	802801-02	MONITOR, Generic, Lifepak 8	C	REF
	802801-03	MONITOR, Generic, Lifepak 8	D	REF
A1	802823-01	. MAIN PFC ASSEMBLY (See Figure 5-20) ATTENTION		1
A2	802815-02	. POWER SUPPLY PCB ASSEMBLY (See Figure 5-10) ATTENTION	A,B	1
	802815-03	. POWER SUPPLY PCB ASSEMBLY	C,D	1
A3	802821-02	. CHARGER PCB ASSEMBLY (See Figure 5-9)	A	1
	802821-04	. CHARGER PCB ASSEMBLY	B	1
	802821-07	. CHARGER PCB ASSEMBLY	C,D	1
A4	802833-03	. ECG PCB ASSEMBLY (See Figure 5-11) ATTENTION	A,B	1
	802833-06	. ECG PCB ASSEMBLY	C,D	1
A5	802835-04	. GATEWAY PCB ASSEMBLY (See Figure 5-13) ATTENTION	A,B	1
	802835-05	. GATEWAY PCB ASSEMBLY	C,D	1
A6	802827-04	. CONTROL PCB ASSEMBLY (See Figure 5-12) ATTENTION		1
A7	802831-02	. CRT PCB ASSEMBLY (See Figure 5-14)	A-C	1
	202831-03	. CRT PCB ASSEMBLY	D	1
A8	802813-01	. ANODE SUPPLY PCB ASSEMBLY (See Figure 5-15)		1
A9	802819-05	. RECORDER PFC ASSEMBLY (See Figure 5-16A) ATTENTION	A,B	1
	802819-06	. RECORDER PFC ASSEMBLY	C,D	1
A10	802829-01	. REAR PANEL PCB ASSEMBLY (See Figure 5-6)		1
A11	802844-01	. LOWER SWITCH MODULE PCB ASSEMBLY (Not Shown, See Figures 5-3, 5-18)		1
A12	802845-01	. UPPER SWITCH MODULE PCB ASSEMBLY (Not Shown, See Figures 5-2, 5-17)		1
A13	802854-00	. RECORDER ASSEMBLY (See Figure 5-7A)	A,B	1
	802854-02	. RECORDER ASSEMBLY	C,D	1
	802853-00	. RECORDER ASSEMBLY (See Figure 5-7B)	D	1
2	802850-00	. BATTERY ASSEMBLY		1
3	803552-00	. CABLE ASSEMBLY, Recorder/Recorder PFC, MFE		1
	803552-01	. CABLE ASSEMBLY, Recorder/Recorder PFC, GSI		1
4	200536-009	. CABLE, Tie, Self Locking, Nylon, .10 W X 3.50 L		6
5	802802-01	. CASE ASSEMBLY, Front, W/Inserts	A,B	1
	802802-03	. CASE ASSEMBLY, Front, W/Inserts	C,D	1
6	802809-01	. CASE ASSEMBLY, Rear, W/Inserts	A-C	1
	802809-03	. CASE ASSEMBLY, Rear, W/Inserts	D	1
7	201439-001	. CLAMP, Component Steel		2
8	200419-019	. CONNECTOR, Housing, Receptacle, Locking, 2 Contact		1
9	803325-00	. CONNECTOR, Module A, W/Inserts		2
10	803651-00	. CONTACT, Spring, Rear Panel		1
11	802754-01	. COVER, LED		2
12	90-10034	. FASTENER, Mount, Cable Tie, Screw Mount	A,C	1
	201472-003	. FASTENER, Mount, Cable Tie, Screw Mount	D	1
13	200437-011	. GUIDE, Card, Snap-In		2
14	803326-00	. HOUSING, Recorder, W/Inserts		1
15	802874-00	. INSERT, Handle		1
16	803668-00	. INSULATOR, CRT Connector		1
17	803667-00	. INSULATOR, Front Case (Not Shown)		1
18	803666-00	. INSULATOR, Interconnect (Used on Item 9, Not Shown)		1
19	803641-00	. INSULATOR, Lower Switch Panel		1
20	803640-00	. INSULATOR, Upper Switch Panel		1
21	800972-00	. LABEL, Paper Loading, Recorder (Not Shown)		1
22	803456-10	. LABEL, Specification, Battery Pack		2
23	803456-12	. LABEL, Specification, Battery Pack		1
24	802805-00	. LEAD ASSEMBLY, Battery		1
25	201820-003	. LED, T-1 3/4, Low Profile, High Intensity, Red		1
26	803504-01	. PLATE, Mounting, Recorder, W/Inserts (Not Shown)		1
27	802808-03	. REAR PANEL ASSEMBLY	A,B	1
	802808-04	. REAR PANEL ASSEMBLY	C	1
	802808-05	. REAR PANEL ASSEMBLY	D	1
28	90-10046	. RETAINER, Clip, Wire (Not Shown)	A,B	1
	202039-001	. RETAINER, Clip, Wire	C,D	1
29	201858-000	. RETAINER, LED, One Piece, Round		1
30	200364-041	. RETAINER, PCB, Support, Locking, Nylon, .25 L		2
31	200364-046	. RETAINER, PCB, Support, Locking, Nylon, .62 L		4
32	804511-01	. SCREEN VENT, Rear Case	D	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-4				
33	201859-568	. SCREW, Flat Head, 6-32 X .250 L	A-C	5
	201859-570	. SCREW, Flat Head, 6-32 X .250 L	D	5
34	200531-002	. SCREW, Pan Head, 4-40 X .250 L		4
35	200476-760	. SCREW, Pan Head, 4-40 X .250 L		20
36	200476-820	. SCREW, Pan Head, 6-32 X 2.000 L		2
37	200476-794	. SCREW, Pan Head, 6-32 X .375 L		20
38	803971-00	. SHIELD, Battery (Not Shown)	C	1
39	803678-00	. SHIELD, CRT (Not Shown)		1
40	802889-02	. SHIELD, Recorder, Mμ Metal (Not Shown)		1
41	804447-00	. SPACER, Foam, CRT (Not Shown)	C,D	2
42	804447-05	. SPACER, Foam, PCB, Notched (Not Shown)	D	1
43	804447-01	. SPACER, Foam, PCB, Single (Not Shown)	C	2
	804447-03	. SPACER, Foam, PCB, Single	D	1
44	804447-02	. SPACER, Foam, PCB, Triple (Not Shown)	C	2
	804447-04	. SPACER, Foam, PCB, Triple	D	2
45	802858-01	. SPEAKER ASSEMBLY	A,B	1
	802271-00	. SPEAKER ASSEMBLY	C,D	1
46	201118-089	. STANDOFF, Hex, F/F, 6-32 X 2.000 L/.250 W		2
47	201286-114	. STANDOFF, Hex, M/F, 6-32 X 2.000 L/.250 W		2
48	200302-090	. STANDOFF, Hex, M/F, 6-32 X 3.000 L/.250 W		4
49	90-08006	. TAPE, Double Stick, .500 W		A/R
50	201501-007	. TAPE, Adhesive, Double Stick, .750 W		A/R
51	200906-014	. TAPE, Adhesive, Neoprene, .062 T X 1.00 W	A-C	A/R
	201765-017	. TAPE, Adhesive, Neoprene, .062 T X 1.00 W	D	A/R
52	200906-015	. TAPE, Adhesive, Neoprene, .125 X .500 W	A-C	A/R
	201765-000	. TAPE, Adhesive, Neoprene, .125 T X .500 W	D	A/R
53	90-08030	. TAPE, Adhesive, Mylar, Clear/Yellow, 2.000 W (Not Shown, Used On Recorder Pen Motor)		A/R
54	803620-00	. TAPE, Cover, Connector Module (Not Shown, Used On #9)		2
55	200712-000	. TAPE, Polyester, Thermosetting, Adhesive (Not Shown, Used On Printhead Flex)		A/R
56	200390-001	. TERMINAL, Socket, Crimp, 22-30 AWG		4
57	90-10049	. TERMINAL, Splice, Brass (Not Shown)		A/R
58	200283-003	. TUBING, Heat Shrink, Bed, .125 10A		A/R
59	200319-003	. TUBING, Teflon, Natural, .294 ID, 2.00 L		2
60	200357-109	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Black		A/R
61	200357-110	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Red		A/R

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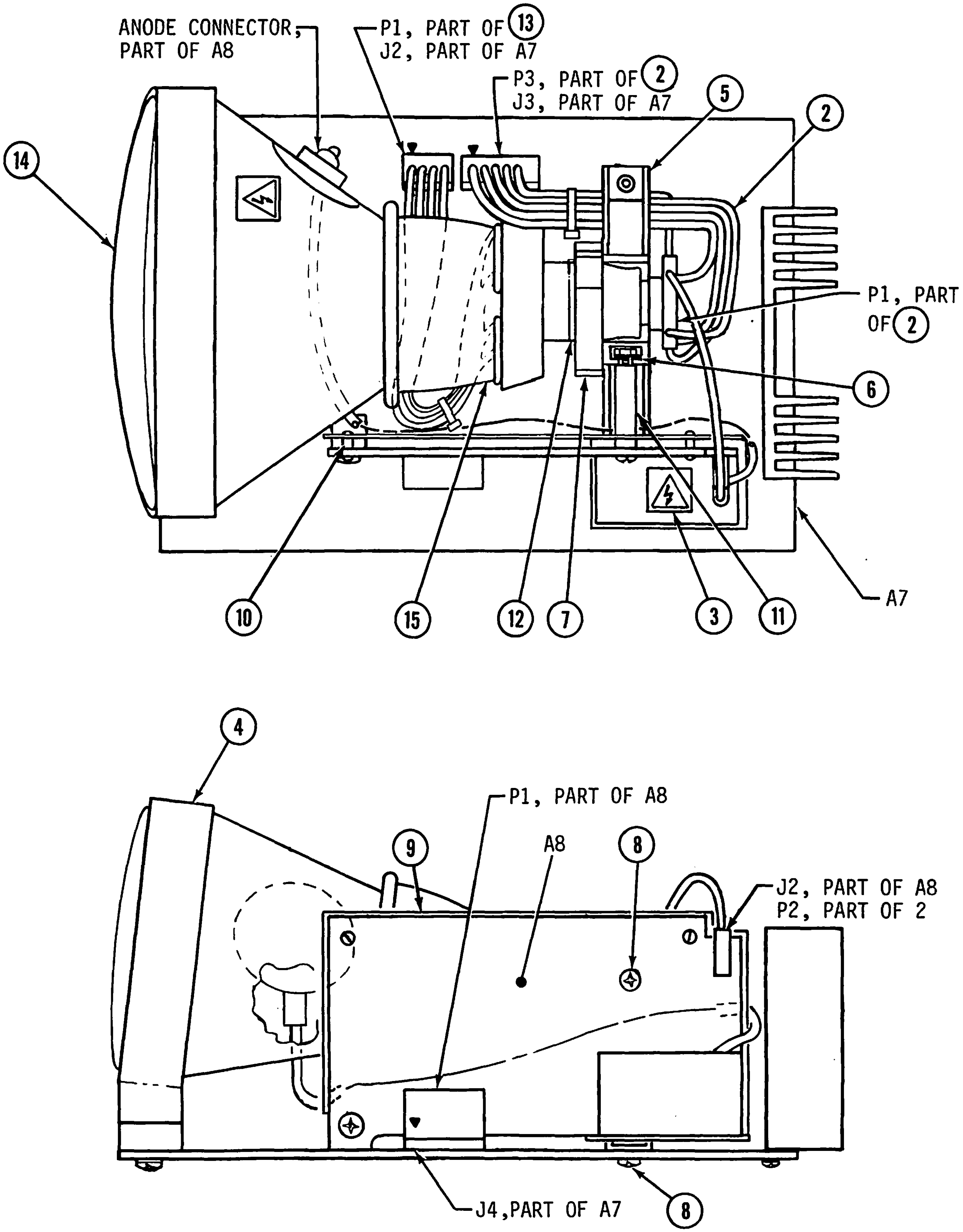
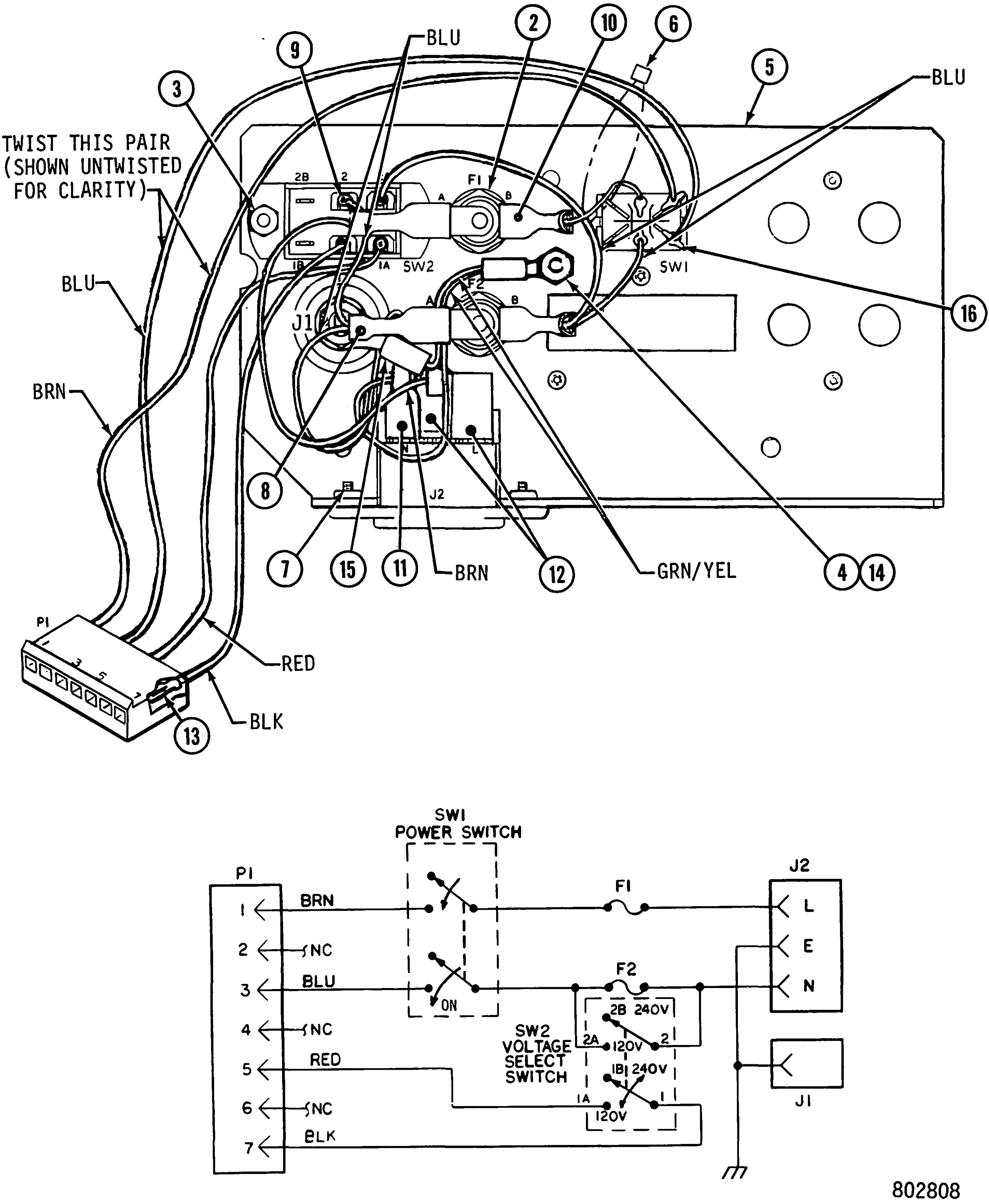

ANODE CONNECTOR,
PART OF A8
P1, PART OF ⑬
J2, PART OF A7
P3, PART OF ②
J3, PART OF A7
⑤
②
⑭
P1, PART
OF ②
⑥
A7
⑩
⑮
⑫
⑦
③
⑪
④
P1, PART OF A8
⑨
A8
⑧
J2, PART OF A8
P2, PART OF 2
J4,PART OF A7
⑧

FIGURE 5-5. CRT ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-5 Part of	802801	CRT ASSEMBLY		REF
A7	802831-02	. CRT PCB ASSEMBLY (Figure 5-14)		1
	802831-03	. CRT PCB ASSEMBLY		REF
A8	802813-01	. ANODE SUPPLY PCB ASSEMBLY (Figure 5-15)		1
2	802877-00	. CONNECTOR ASSEMBLY, CRT		1
3	800943-09	. LABEL, Symbol, International High Voltage		2
4	802880-01	. MOUNT, Front, CRT		1
5	802881-01	. MOUNT, Rear, CRT		1
6	90-03020	. NUT, Hex, Kep, 6-32 X .312 W		1
7	200536-003	. CABLE TIE, Self Locking, Nylon, .19 W X 8.0 L		1
8	200476-793	. SCREW, Pan Head, 6-32 X .312 L		6
9	804513-01	. SHIELD, Anode Supply		1
10	200032-001	. SPACER, Snap-In		2
11	200192-022	. STANDOFF, Hex, M/F, 6-32 X .875 L		1
12	200318-003	. TAPE, Adhesive, Sponge, Black, .500 W X .125 T		A/R
13	90-08001	. TAPE, Adhesive, Transfer, .750 W X .002 T (Applied to Neck of CRT, Not Shown)		A/R
14	800284-02	. TUBE, Cathode Ray		1
15	802849-00	. YOKE, CRT		1


TWIST THIS PAIR (SHOWN UNTWISTED FOR CLARITY)
2
10
6
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3
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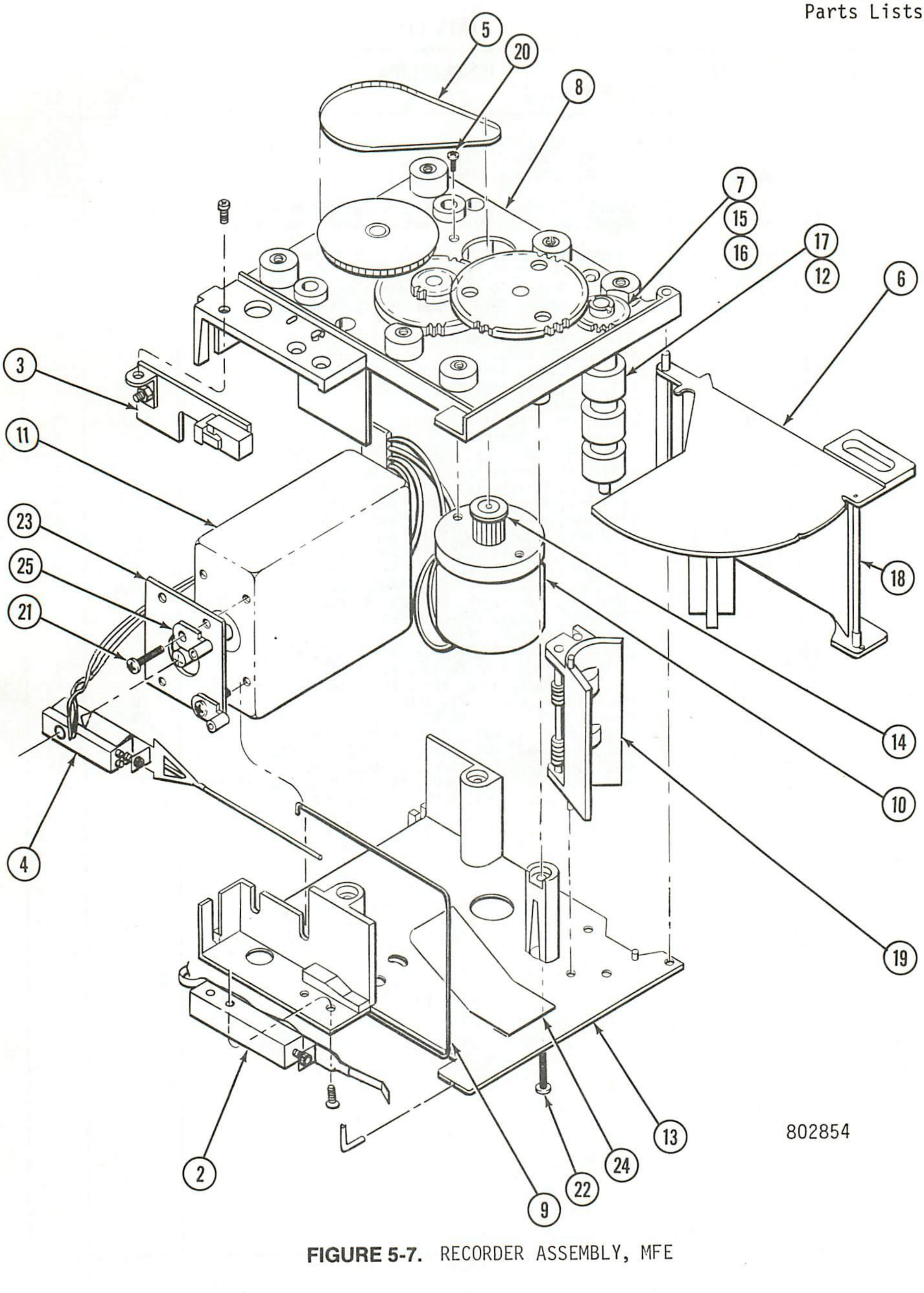
BLU
BLU
BLU
BRN
2B
2
1B
1A
SW2
F1
A
B
F2
A
B
J1
SW1
16
8
J2
N
L
7
15
11
BRN
12
GRN/YEL
4
14
P1
1
3
5
7
RED
BLK
13
SW1
POWER SWITCH
P1
1
2
3
4
5
6
7
BRN
NC
BLU
NC
RED
NC
BLK
ON
F1
F2
J2
L
E
N
J1
SW2
VOLTAGE
SELECT
SWITCH
2B 240V
2A
120V
2
1B
240V
1A
120V
1
802808

FIGURE 5-6. REAR PANEL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-6				
	802808-03	REAR PANEL ASSEMBLY, Monitor	A	REF
	802808-04	REAR PANEL ASSEMBLY, Monitor	B	REF
	802808-05	REAR PANEL ASSEMBLY, Monitor	C	REF
J1	201393-011	. CONNECTOR, Plug, Potential Equal, VDE, Panel Assembly		1
J2	201296-001	. CONNECTOR, Plug, Power, ac, 3 Contact, 6A/250 V		1
P1	200277-005	. CONNECTOR, Housing, Receptacle, 7 Contact		1
SW1	201665-001	. SWITCH, Rocker, Quick Disconnect Insul, 250V		1
SW2	201150-000	. SWITCH, Slide, Main, Panel Mount, 2A/250V		1
2	201203-002	. FUSEHOLDER, Panel Mount, 3AG	A	2
	201203-016	. FUSEHOLDER, Body	B,C	2
3	90-03019	. NUT, Hex, Kep, 4-40 X .250W/.098T		2
4	90-03021	. NUT, Hex, Kep, 6-32 X .25 W/.098		1
5	802879-02	. PANEL, Rear, Monitor	A	1
	802879-04	. PANEL, Rear, Monitor	B	1
	802879-05	. PANEL, Rear, Monitor	C	1
6	200536-008	. RETAINER, Cable Tie, Nylon, .125 W X 5.50 L		4
7	200478-761	. SCREW, Flat Head, 4-40 X .312 L		2
8	200267-008	. TERMINAL, Receptacle, 16-14 AWG, .187	A	2
	200267-007	. TERMINAL, Receptacle, 16-14 AWG, .187	B,C	2
9	200267-040	. TERMINAL, Receptacle, 22-18 AWG, .110 X .032		4
10	200267-021	. TERMINAL, Receptacle, 22-18 AWG, .187	A	2
	200267-020	. TERMINAL, Receptacle, 22-18 AWG, .187	B,C	2
11	200267-001	. TERMINAL, Receptacle, 22-18 AWG, .250	A	1
	200267-026	. TERMINAL, Receptacle, 22-18 AWG, .250	B,C	1
12	200514-000	. TERMINAL, Receptacle, 90°, 22-18 AWG, .032 X .250T,		2
13	200390-017	. TERMINAL, Socket, Crimp, 22-18 AWG	A	4
	200390-016	. TERMINAL, Socket, Crimp, 22-18 AWG	B,C	4
14	200276-207	. TERMINAL, Lug, Ring Tongue, 16-14 AWG, #6		1
15	200276-212	. TERMINAL, Lug, Ring Tongue, 22-16 AWG		1
16	200916-003	. TERMINAL, Receptacle, 22-18 AWG, .187 X .032		4
17	201756-012	. TUBING, PVC, Clear, #10 AWG	B,C	A/R
18	201756-018	. TUBING, PVC, Clear, #4 AWG	B,C	A/R
19	200357-055	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Black		A/R
20	200357-059	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Blue		A/R
21	200357-060	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Brown		A/R
22	200357-272	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Green/Yellow		A/R
23	200357-056	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Red		A/R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802854

FIGURE 5-7. RECORDER ASSEMBLY, MFE

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-7A				
A13	802854-01	RECORDER ASSEMBLY, MFE	A	REF
	802854-02	RECORDER ASSEMBLY, MFE	B	REF
2	802842-00	. PRINTHEAD ASSEMBLY		1
3	802841-00	. STATIC PROTECTION PCB ASSEMBLY	B	1
4	801553-00	. STYLUS		1
		THE FOLLOWING ARE MFE CORPORATION PART NUMBERS		
5	30413090	. BELT		1
6	13000190	. CARRIAGE		1
7	31071178	. GEAR		1
8	13000200	. GEAR TRAIN		1
9	30243281	. LATCH, Carriage		1
10	11080300	. MOTOR, Paper Drive		1
11	19996360	. MOTOR, Stylus		1
12	3040018	. O-RING		2
13	30254270	. PLATE, Upper		1
14	13000005	. PULLEY ASSEMBLY		1
15	50015100	. RING, Compression		1
16	50008190	. ROLL PIN		1
17	30235006	. ROLLER, Feed		1
18	31405012	. ROLLER, Knife Edge		1
19	13000112	. ROLLER, Pinch		1
20	50085000	. SCREW, 6-32 X .187		2
21	50095033	. SCREW, 6-32 X .375		4
22	50410075	. SCREW, 4-20 X .625		2
23	30260012	. SPACER, Stylus Motor		1
24	30303135	. SPRING, Paper Tension		1
25	30409023	. STOP, Stylus Velocity Servo		2

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-7B A13	802811-00	RECORDER ASSEMBLY, GSI		REF
2	GSI1132-43004	. ADHESIVE, Loctite 222 (Not Shown)		A/R
3	GSI1152-10003	. BELT, Timing		1
4	GSI1618-108831	. CABLE ASSEMBLY		1
5	GSI1615-104713	. CARRIAGE ASSEMBLY		1
6	GSI1625-06450	. . ANTI-REROLL (Not Shown)		1
7	GSI1615-063601	. . KNIFE EDGE ASSEMBLY (Not Shown)		1
8	GSI1625-05280	. . PLATEN (Not Shown)		1
9	GSI1625-052902	. . POST, Paper (Not Shown)		1
10	GSI1625-06264	. . ROLLER, Pinch (Not Shown)		2
11	GSI1625-06448	. . SHAFT, Pinch Roller (Not Shown)		1
12	GSI1620-05667	. . SPRING, Anti-reroll (Not Shown)		1
13	GSI161C-112661	. CHART DRIVE ASSEMBLY		1
14	GSI1624-10853	. CHASSIS, Left Half		1
15	GSI1624-05282	. CHASSIS, Right Half		1
16	GSI1620-05289	. CLIP, Retaining, PCB		2
17	GSI1615-05286	. DRIVE ROLLER ASSEMBLY		1
18	GSI1000-GVM734	. GALVANOMETER		1
19	GSI1151-00001	. INSERT		4
20	GSI1151-00002	. INSERT		2
21	GSI1420-06175	. NAMEPLATE		1
22	GSI1140-1008	. NUT, Hex, 4-40		4
23	803552-01	. RIBBON CABLE		1
24	GSI115S-L0852	. SCREW, 2.5 X .45 X 8mm		2
25	GSI115S-4A7362	. SCREW, 4-40 X 2 9/32 (Not Shown)		4
26	GSI115S-40662	. SCREW, 4-40 X 3/8		2
27	GSI115S-60652	. SCREW, 6-32 X 3/8		1
28	GSI115S-60652W6	. SCREW, With Washer, 6-32 X 3/8		3
29	GSI1620-09221	. SHAFT, Roller Drive		1
30	GSI1620-05291	. SPRING, Flexure		2
31	GSI1624-11261	. STOP, Pen		1
32	801553-00	. STYLUS		1
33	GSI1625-04015T	. TUMBLE, Pen Lift Bar		1
34	GSI1625-04015	. . BAR, Pen Lift (Not Shown)		1
35	GSI1139-40002	. WASHER, Curved Spring (Not Shown)		1
36	GSI1624-04014	. WASHER, Drive Roller		2
37	GSI1139-10003	. WASHER, Lock, #3		2
38	GSI1620-05294	. WRAP, Tie		1

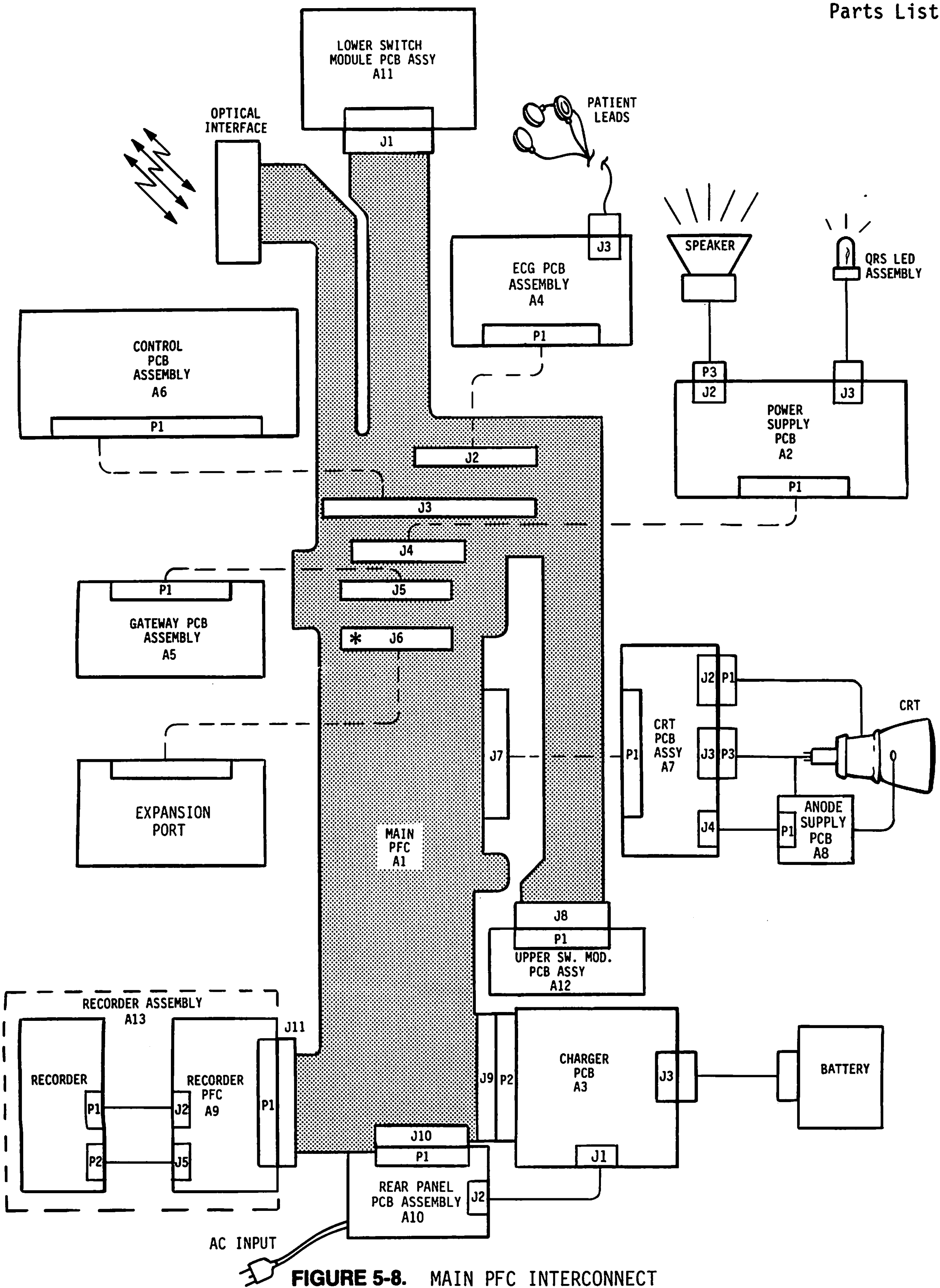
LOWER SWITCH
MODULE PCB ASSY
A11
J1
OPTICAL
INTERFACE
PATIENT
LEADS
J3
ECG PCB
ASSEMBLY
A4
P1
SPEAKER
QRS LED
ASSEMBLY
P3
J2
J3
POWER
SUPPLY
PCB
A2
P1
CONTROL
PCB
ASSEMBLY
A6
P1
J2
J3
J4
J5
P1
GATEWAY PCB
ASSEMBLY
A5
* J6
EXPANSION
PORT
J7
P1
CRT
PCB
ASSY
A7
J2
P1
J3
P3
J4
CRT
P1
ANODE
SUPPLY
PCB
A8
MAIN
PFC
A1
J8
P1
UPPER SW. MOD.
PCB ASSY
A12
RECORDER ASSEMBLY
A13
RECORDER
P1
P2
RECORDER
PFC
A9
J2
J5
P1
J11
J9
P2
CHARGER
PCB
A3
J3
J1
BATTERY
J10
P1
REAR PANEL
PCB ASSEMBLY
A10
J2
AC INPUT

FIGURE 5-8. MAIN PFC INTERCONNECT
(SHEET 1 OF 4)

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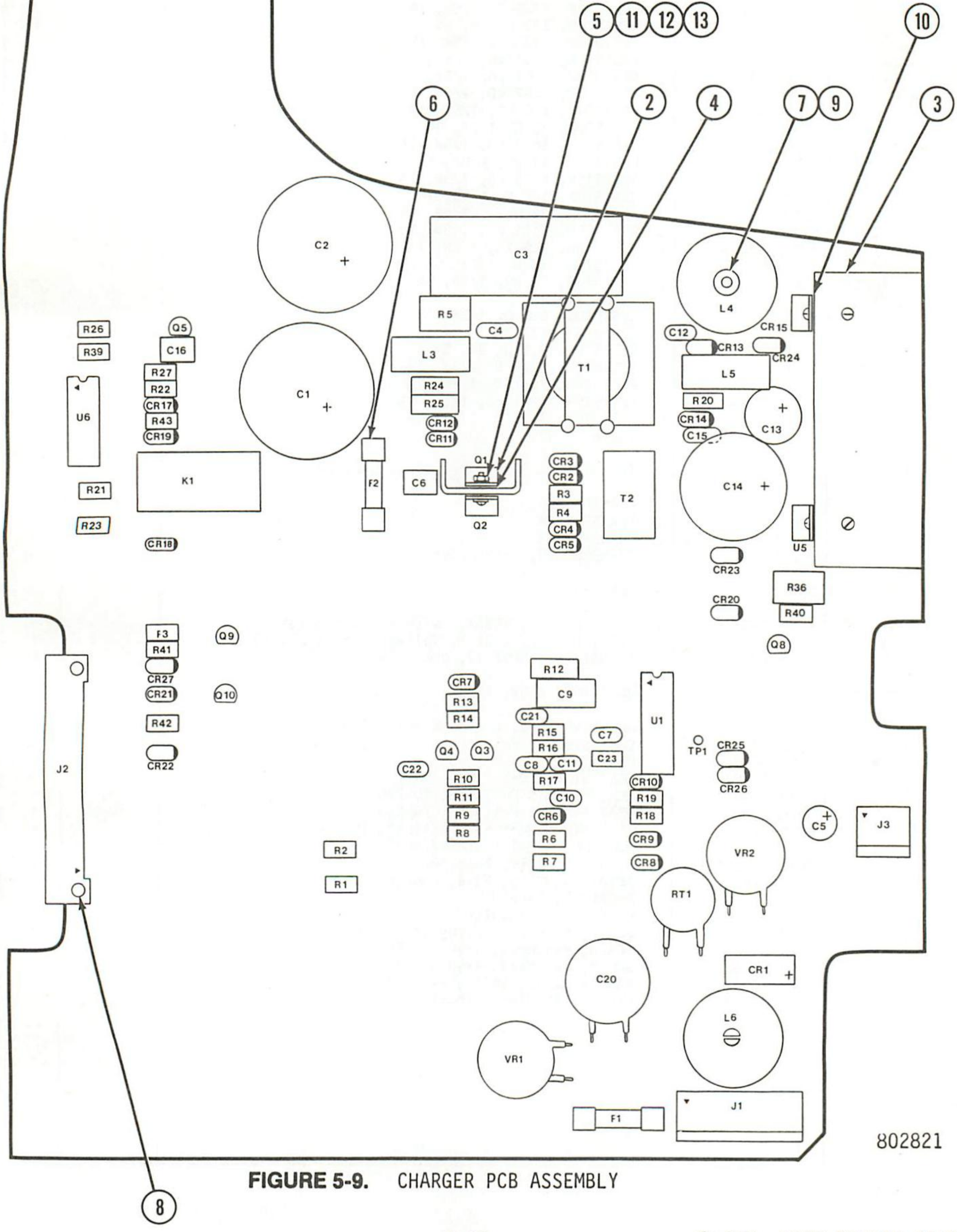
PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-9				
A3	802821-02	CHARGER PCB ASSEMBLY	A	REF
	802821-04	CHARGER PCB ASSEMBLY	B	REF
	802821-07	CHARGER PCB ASSEMBLY	C	REF
C1,2	201849-000	. CAPACITOR, Electrolytic, 220μF, 250V		2
C3	200680-013	. CAPACITOR, 1μF/400V, 10%		1
C4	200593-001	. CAPACITOR, 100pF/1kV, 10%		1
C5	200205-036	. CAPACITOR, Electrolytic, 22μF/35V, 10%	A,B	1
	200205-027	. CAPACITOR, Electrolytic, 47μF/25V, 10%	C	1
C6	201628-078	. CAPACITOR, 1.0μF/50V		1
C7	200893-034	. CAPACITOR, .10μF/50V, 10%		4
C8	200901-039	. CAPACITOR, 2700pF/50V, 5%		1
C9	200744-001	. CAPACITOR, .047μF/50V, 5%		1
C10	200901-022	. CAPACITOR, 100pF/50V, 5%		1
C11	200893-030	. CAPACITOR, .047μF/50V, 10%	A,B	1
		. (Same As C7)	C	
C12	200893-063	. CAPACITOR, 1000pF/100V, 10%		1
C13	200701-032	. CAPACITOR, Electrolytic, 22μF/50V, 10%		1
C14	200322-058	. CAPACITOR, Electrolytic, 470μF/50V, +100-10%		1
C15	201628-132	. CAPACITOR, .1μF/50V, 20%		1
C16	201628-135	. CAPACITOR, .33μF/50V, 20%		1
C20	200507-017	. CAPACITOR, Ceramic Disc, .05μF, Radial Lead	A,B	1
	200507-030	. CAPACITOR, Ceramic Disc, .01μF, Radial Lead	C	1
C21,22		. (Same As C7)		
C23	201628-006	. CAPACITOR, .01μF/50V, 5%	C	1
CR1	200499-019	. DIODE, Bridge, FWLA1000 2A/PRV 1000		1
CR2-5	200605-017	. DIODE, Zener, 1N4745A, 285mA/16V		4
CR6	200086-027	. DIODE, Zener, 1N4112, 13.2mA/18V		1
CR7	200086-011	. DIODE, Zener, 1N4625, 55mA/5.1V		1
CR8,9	200234-035	. DIODE, Zener, 1N992B, 1.5mA/200V		2
CR10	200086-019	. DIODE, Zener, 1N4104, 24.8mA/10V		1
CR11,12	200658-002	. DIODE, MR812, 200nS/PIV 200		2
CR13,14	201128-000	. DIODE, 3XF1, 250nS/PIV 10	A,B	2
	200658-002	. DIODE, MR812, 200nS/PIV 200	C	2
CR15	201320-001	. DIODE, Dual, Common Cathode, 100nS/PIV 100		1
CR17	200086-014	. DIODE, Zener, 1N4099, 35mA/6.8V		1
CR18	200971-000	. DIODE, 1N914B, 8nS/PIV 75		2
CR19	200086-024	. DIODE, Zener, 1N4109, 3mA/15V		1
CR20-22	200284-001	. DIODE, 1N4001, 1A/PIV 50		3
CR23	200233-083	. DIODE, Zener, 1N5360, 5W, 25V		1
CR24	200233-089	. DIODE, Zener, 1N5366A, 5W, 39V		1
CR25,26	200083-001	. DIODE, 1N5818, 1A, 30V		2
CR27		. (Same As CR18)		
F1	200603-016	. FUSE, Quick Acting, 250V, 3.15A		1
F2	200619-011	. FUSE, Slow Blow, 400mA		1
F3	201167-015	. FUSE, Fast, 10A, 125V		1
J1	200096-005	. CONNECTOR, Plug, Locking, 7 Contact		1
J2	201678-031	. CONNECTOR, DIN, Male, 90°, 32 Contact		1
J3	200096-001	. CONNECTOR, Plug, Locking, 3 Contact		1
K1	201537-016	. RELAY, Miniature, 24V Coil		1
L3	200615-015	. INDUCTOR, RF, 2.5mH		1
L4	800908-00	. INDUCTOR, Coil, Toroid, 300μH	A,B	1
	800908-01	. INDUCTOR, Coil, Toroid, 217μH	C	1
L5	200615-014	. INDUCTOR, RF, 1mH		1
L6	802525-00	. INDUCTOR, RFI Suppression		1
Q1,2	201569-000	. TRANSISTOR, NPN, IRF830, MOSFET, TO-22 ATTENTION		2
Q3	200888-001	. TRANSISTOR, PNP, 2N2907, TO-92		2
Q4	200791-001	. TRANSISTOR, NPN, PN3904, TO-92		1
Q5		. (Same As Q3)		
Q8-10	200883-000	. TRANSISTOR, PNP, PN3905, TO-92		3
R1,2	200471-128	. RESISTOR, 220 kΩ, 1/2W, 5%		2

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-9				
R3,4	200054-069	. RESISTOR, 49.9 Ω, 1/8W, 1%		2
R5	200676-039	. RESISTOR, 390 Ω, 3W, 5%		1
R6,7	200054-434	. RESISTOR, 332 kΩ, 1/8W, 1%		2
R8	200054-356	. RESISTOR, 51.1 kΩ, 1/8W, 1%		1
R9	200054-239	. RESISTOR, 3.01 kΩ, 1/8W, 1%		3
R10	200054-246	. RESISTOR, 3.57 kΩ, 1/8W, 1%		1
R11	200054-193	. RESISTOR, 1.0 kΩ, 1/8W, 1%		1
R12	200471-031	. RESISTOR, 20 Ω, 1/2W, 5%		1
R13	200054-307	. RESISTOR, 15.8 kΩ, 1/8W, 1%		1
R14	200054-292	. RESISTOR, 11 kΩ, 1/8W, 1%		1
R15	200054-257	. RESISTOR, 4.75 kΩ, 1/8W, 1%		1
R16	200054-097	. RESISTOR, 100 Ω, 1/8W, 1%		1
R17	200054-326	. RESISTOR, 24.9 kΩ, 1/8W, 1%		1
R18	200054-260	. RESISTOR, 5.11 kΩ, 1/8W, 1%		1
R19	200054-210	. RESISTOR, 1.5 kΩ, 1/8W, 1%		1
R20	200471-036	. RESISTOR, 33 Ω, 1/2W, 5%		1
R21,22	200054-317	. RESISTOR, 20 kΩ, 1/8W, 1%		4
R23		. (Same As R9)		
R24,25	200471-017	. RESISTOR, 5.1 Ω, 1/2W, 5%		2
R26,27		. (Same As R21)		
R36	200270-047	. RESISTOR, 9.1 Ω, 2W, 5%		1
R39	200054-078	. RESISTOR, 63.4 Ω, 1/8W, 1%		1
R40	200054-042	. RESISTOR, 26.7 Ω, 1/8W, 1%		1
R41	200054-296	. RESISTOR, 12.1 kΩ, 1/8W, 1%		1
R42	200054-054	. RESISTOR, 35.7 Ω, 1/8W, 1%		1
R43		. (Same As R9)		
RT1	200486-004	. THERMISTOR, Surge Arresting, 5 Ω, 2W		1
T1	802861-01	. TRANSFORMER	A	1
	802861-03	. TRANSFORMER	B	1
	802861-04	. TRANSFORMER	C	1
T2	802847-03	. TRANSFORMER, Gate Drive		1
TP1	801959-00	. TEST POINT		1
U1	201126-000	. I.C., Linear, 3525A, Pulse Width Modulator		1
U5	200414-000	. I.C., Linear, LM317T, Voltage Regulator, TO-220		1
U6	200942-002	. TRANSISTOR, MPQ2222, Quad, 14 Pin DIP		1
VR1,2	201251-168	. VARISTOR, 350V, 4500A		2
2	201501-007	. ADHESIVE TAPE, Double Stick, .75W		A/R
3	201566-035	. CAP, Sleeve, Polyethylene, Red, 1.250 ID		2
4	200153-000	. HEAT SINK	A,B	1
	202091-007	. HEAT SINK, TO-5	C	1
5	802893-00	. HEAT SINK, 5 Position, TO-220	A,B	1
	802893-01	. HEAT SINK, 5 Position, TO-220	C	1
6	90-09227	. INSULATOR, Heat Sink Silipad, TO-220		4
7	201199-100	. NUT, Hex, 4-40 X .188W/.063T		1
8	201156-001	. RETAINER, Clip, Fuse, Brass		2
9	201529-002	. RETAINER, Clip, Fuse, Copper, .25		2
10	200681-000	. RETAINER, Toroid		1
11	201773-000	. RIVET, Semi-Tubular		2
12	90-01235	. SCREW, Binder Head, Nylon, 4-40 X .5L		1
13	200476-760	. SCREW, Pan Head, 4-40 X .250		4
14	200476-762	. SCREW, Pan Head, 4-40 X .375L		1
15	90-04061	. WASHER, Lock, Split, #4 X .195W		1
16	200431-849	. WASHER, Shoulder, Insulating		4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C4
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CR24
R26
Q5
R39
C16
L3
T1
L5
R27
R22
U6
CR17
R43
CR19
C1
R24
R25
CR12
CR11
R20
CR14
C15
C13
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F2
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T2
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R18
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R11
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CR6
R6
R7
CR9
CR8
C5
J3
VR2
R2
R1
RT1
C20
CR1
L6
VR1
F1
J1
802821
8

FIGURE 5-9. CHARGER PCB ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-10 A2	802815-02	POWER SUPPLY PCB ASSEMBLY	A	REF
	802815-03	POWER SUPPLY PCB ASSEMBLY	B	REF
C1,2	200893-034	. CAPACITOR, .10µF/50V, 10%	A	7
		. (Same As C1)	B	8
C3	200893-042	. CAPACITOR, .47µF/50V, 10%		1
C4	200204-062	. CAPACITOR, Electrolytic, 2.2µF/50V, 10%		1
C5	200893-022	. CAPACITOR, .01µF/50V, 10%	A	3
		. (Same As C1)	B	
C6	200901-034	. CAPACITOR, 1000pF/50V, 5%		1
C7	200901-201	. CAPACITOR, 68pF/100V, 10%		1
C8		. (Same As C1)	A	
		. (Same As C1)	B	
C9	200205-035	. CAPACITOR, Electrolytic, 10µF/35V, +50%		1
C10		. (Same As C1)	A	
		. (Same As C1)	B	
C11	200205-046	. CAPACITOR, Electrolytic, 2.2µF/50V, 10%	A	2
		. (Same As C11)	B	2
C12	200901-042	. CAPACITOR, 4700pF/50V, 5%		1
C13	201628-010	. CAPACITOR, .047µF/50V, 5%		1
C14		. (Same As C1)	A	
		. (Same As C1)	B	
C15	201628-018	. CAPACITOR, 1.0µF/50V, 5%	A	1
		. (Same As C15)	B	2
C16	200322-059	. CAPACITOR, Electrolytic, 680µF/40V, 100%		1
C17	201628-012	. CAPACITOR, .1µF/50V, 5%	A	3
		. (Same As C17)	B	2
C18	200701-004	. CAPACITOR, Electrolytic, 470µF/10V, 20%		
C19	200701-021	. CAPACITOR, Electrolytic, 10µF/35V, 20%		1
C20	200701-019	. CAPACITOR, Electrolytic, 330µF/25V, 20%	A	3
	200322-009	. CAPACITOR, Electrolytic, 1000µF/25V, 100%	B	1
C21	200701-027	. CAPACITOR, Electrolytic, 220µF/35V, 20%		1
C22	200701-051	. CAPACITOR, Electrolytic, 10µF/100V, 20%		1
C23		. (Same As C18)		
C24,25		. (Same As C20)	A	
	200701-019	. CAPACITOR, Electrolytic, 330µF/25V, 20%	B	2
C26	200893-059	. CAPACITOR, 470pF/100V, 10%	B	1
C27		. (Same As C11)	B	
C102	200744-013	. CAPACITOR, .47µF/50V, 5%		1
C103	201628-014	. CAPACITOR, .22µF/50V, 5%	A	1
		. (Same As C103)	B	3
C104	200744-011	. CAPACITOR, .33µF/50V, 5%		1
C105		. (Same As C5)	A	
	200893-022	. CAPACITOR, .01µF/50V, 10%	B	2
C106	200893-046	. CAPACITOR, 1.0µF/50V, 10%		1
C111		. (Same As C5)	A	
		. (Same As C105)	B	
C112		. (Same As C1)	A	
		. (Same As C1)	B	
C113-118	200049-039	. CAPACITOR, .1µF/50V, 20%		6
C201		. (Same As C17)	A	
		. (Same As C15)	B	
C202		. (Same As C11)	A	
		. (Same As C103)	B	
C203	200893-014	. CAPACITOR, 2200pF/50V, 10%	A	1
	200744-005	. CAPACITOR, .1µF/50V, 5%	B	1
C204		. (Same As C17)	A	
		. (Same As C17)	B	
C205	201628-011	. CAPACITOR, .068µF/50V	A	1
	200744-001	. CAPACITOR, .047µF/50V, 5%	B	1
C301		. (Same As C1)	A	
		. (Same As C1)	B	
C302	200456-087	. CAPACITOR, Electrolytic, 100µF/16V, +75%		4
C303	200893-002	. CAPACITOR, 220pF/50V, 10%	B	2
C304		. (Same As C303)	A	1
		. (Same As C303)	B	
C305		. (Same As C302)		
C306	200204-000	. CAPACITOR, Electrolytic, 47µF/6.3V, +50%		1

PARTS LIST

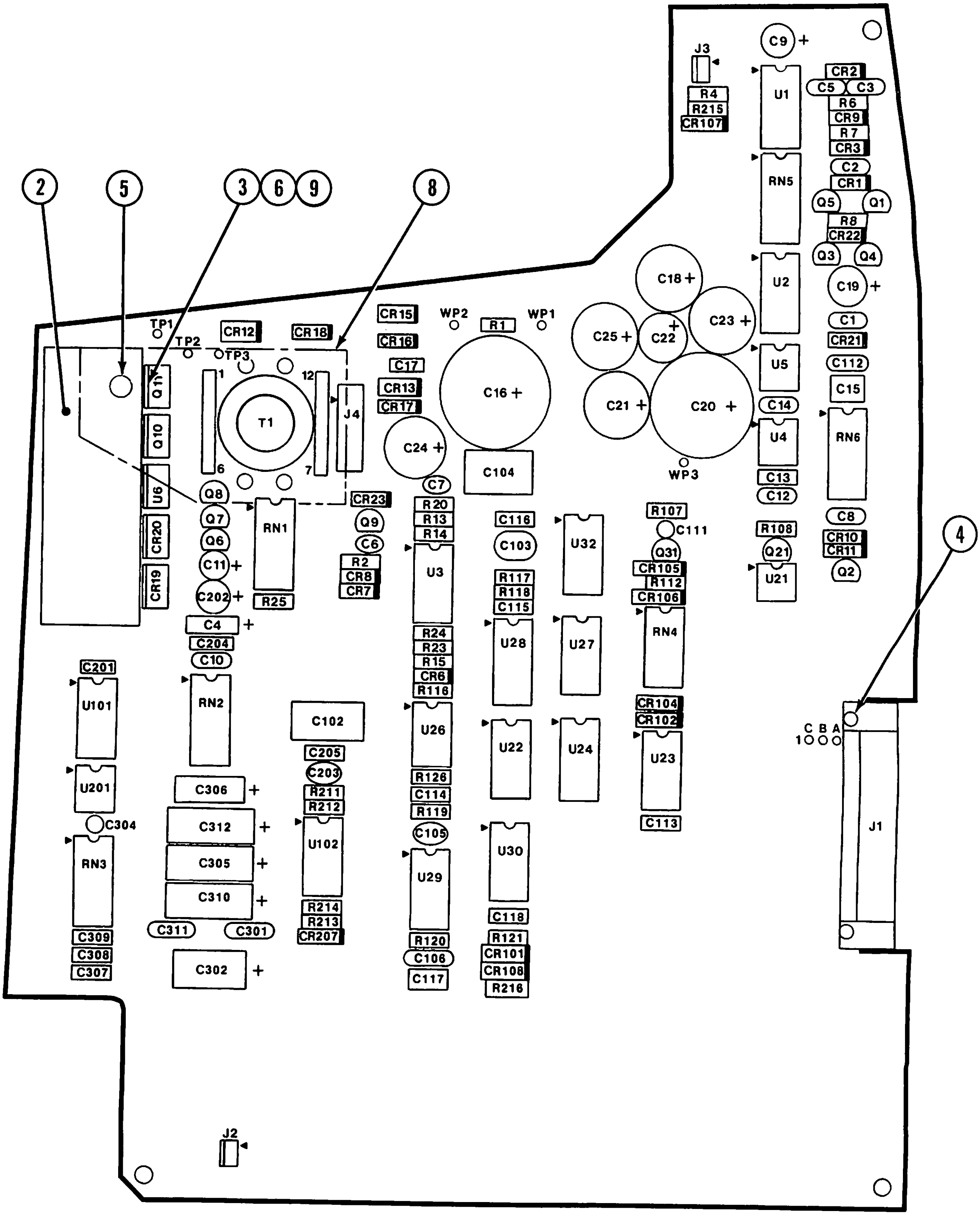
FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-10				
C307-309	200049-022	. CAPACITOR, 3900pF/50V, 20%		3
C310		. (Same As C302)		
C311	200893-038	. CAPACITOR, .22µF/50V, 10%	A	1
		. (Same As C103)	B	
C312		. (Same As C302)		
CR1	200086-021	. DIODE, Zener, 1N4106, .2W, 5%, 20.4mA, 12V		2
CR2,3, 6-10	200971-000	. DIODE, 1N914B, 8nS, PIV 75	A	12
		. DIODE, 1N914B, 8nS, PIV 75	B	14
CR11	200086-006	. DIODE, Zener, 1N4620, .2W, 5%, 80mA, 3.3V		1
CR12	200177-041	. Zener, P6KE47A, 1mA/600W		1
CR13	201391-006	. DIODE, 80SQ030, 3A, 30V		1
CR14	201128-000	. DIODE, 3XF1, 300nS, PIV 10	B	2
CR15	201128-000	. DIODE, 3XF1, 250nS, PIV 10	A	1
		. (Same As CR14)	B	
CR16	200658-002	. DIODE, MR812, 200nS, PIV 200		2
CR17	200605-000	. DIODE, Zener, 1N4728A, 1W, 5%, 1380mA/3.3V		3
CR18		. (Same As CR16)		
CR19	201320-001	. DIODE, Dual Common Cathode, BYV-32, 100nS, PIV 100		1
CR20	201528-001	. DIODE, VHE1402, 10A, 100V		1
CR21		. (Same As CR2)	A	
		. (Same As CR2)	B	
CR22	201372-000	. DIODE, Germanium, 1N270, 200mA, PIV 80		3
CR23		. (Same As CR1)		
CR101		. (Same As CR2)	A	
		. (Same As CR2)	B	
CR102, 104		. (Same As CR22)		
CR105, 106		. (Same As CR17)		
CR107, 108		. (Same As CR2)	A	
		. (Same As CR2)	B	
CR205-206		. (Same As CR2)	B	
CR207		. (Same As CR2)	A	
J1	201678-038	. CONNECTOR, Receptacle, 90°, 48 Contact		1
J2,3	200534-000	. CONNECTOR, Plug, 2 Contact		2
J4	200073-000	. CONNECTOR, Plug, Flex, 6 Contact, Top Entry		1
L1,2	200808-000	. INDUCTOR, Bead, Ferrite (Q10,11 G)		2
Q1	201688-001	. TRANSISTOR, PNP, MPSA63, TO-92	A	2
		. (Same As Q1)	B	1
Q2	801338-01	. TRANSISTOR, VFET, TO-92, VN0106N3 ATTENTION	A	2
	200585-001	. TRANSISTOR, FET, VDS 60, VN0106N3, TO-92	B	3
Q3	200791-001	. TRANSISTOR, NPN, VCEO 40V, 2N3904, TO-92		1
Q4	200883-000	. TRANSISTOR, PNP, VCEO +40V, 2N3905, TO-92		1
Q5	200888-001	. TRANSISTOR, PNP, VCEO 60, PN2907A, TO-92		3
Q6	801232-00	. TRANSISTOR, NPN, VCEO +15, PN2369A, TO-92	A	2
	200857-000	. TRANSISTOR, NPN, VCEO 15V, 2N2369A, TO-92	B	2
Q7		. (Same As Q5)		
Q8		. (Same As Q6)	A	
		. (Same As Q6)	B	
Q9		. (Same As Q2)	A	
		. (Same As Q2)	B	
Q10,11	201334-001	. TRANSISTOR, N-Channel, FET, TO-220AB, IRF531	A	2
	201334-000	. TRANSISTOR, N-Channel, FET, TO-220AB, IRF530	B	2
Q21		. (Same As Q5)		
Q31		. (Same As Q1)	A	
	201738-000	. TRANSISTOR, P-Channel, FET, VP0104 ATTENTION	B	1
Q32		. (Same As Q2)	B	
R1	201527-000	. WIRE, Jumper, Molded, 1/4W	A	1
R2	200470-048	. RESISTOR, 100 Ω, 1/4W, 5%	B	2
R3	200470-041	. RESISTOR, 51 Ω, 1/4W, 5%	B	3

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-10				
R4	200470-072	. RESISTOR, 1 kΩ, 1/4W, 5%	A	1
		. (Same As R4)	B	2
R6	200470-127	. RESISTOR, 200 kΩ, 1/4W, 5%		2
R7	200470-096	. RESISTOR, 10 kΩ, 1/4W, 5%	A	1
		. (Same As R7)	B	2
R8		. (Same As R6)		
R12	200470-017	. RESISTOR, 5.1 Ω, 1/4W, 5%	B	1
R13	200470-041	. RESISTOR, 51 Ω, 1/4W, 5%	A	2
		. (Same As R3)	B	
R14	200054-355	. RESISTOR, 49.9 kΩ, 1/8W, 1%, RN55C		1
R15	200470-061	. RESISTOR, 360 Ω, 1/4W, 5%		1
R20	200470-113	. RESISTOR, 51 kΩ, 1/4W, 5%		1
R23	200054-304	. RESISTOR, 14.7 kΩ, 1/8W, 1%, RN55C		1
R24	200054-377	. RESISTOR, 84.5 kΩ, 1/8W, 1%, RN55C		1
R25	200470-120	. RESISTOR, 100 kΩ, 1/4W, 5%		2
R101		. (Same As R4)	B	
R107	200470-065	. RESISTOR, 510 Ω, 1/4W, 5%		1
R108		. (Same As R13)	A	
		. (Same As R3)	B	
R112	200470-039	. RESISTOR, 43 Ω, 1/4W, 5%		1
R116	200054-413	. RESISTOR, 200 kΩ, 1/8W, 1%, RN55C		1
R117-119	200054-305	. RESISTOR, 15 kΩ, 1/8W, 1%, RN55C		3
R120	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C	A	4
		. (Same As R120)	B	2
R121		. (Same As R25)		
R126		. (Same As R120)	A	
		. (Same As R7)	B	
R211	200470-000	. RESISTOR, 1.0 Ω, 1/4W, 5%		1
R212	200054-105	. RESISTOR, 121 Ω, 1/8W, 1%, RN55C	A	1
		. (Same As R120)	B	
R213, 214		. (Same As R120)	A	
R215	200470-048	. RESISTOR, 100 Ω, 1/4W, 5%	A	1
		. (Same As R2)	B	
R216	200470-088	. RESISTOR, 4.7 kΩ, 1/4W, 5%		1
RN1	802792-12	. RESISTOR NETWORK, Custom, 16 Pin		1
RN2	802792-13	. RESISTOR NETWORK, Custom, 16 Pin	A	1
RN3	802792-14	. RESISTOR NETWORK, 16 Pin, Multi Value		1
RN4	802792-17	. RESISTOR NETWORK, Custom, 16 Pin	A	1
	802792-26	. RESISTOR NETWORK, Multi Value, 16 Pin	B	1
RN5	802792-16	. RESISTOR NETWORK, Multi Value, 16 Pin		1
RN6	802792-15	. RESISTOR NETWORK, Multi Value, 16 Pin		1
T1	802860-00	. TRANSFORMER, Flyback		1
TP1-3	801959-00	. TERMINAL, Test Point		3
U1	2-14426-00	. I.C., Digital, 74C14 Schmidt ATTENTION	A	2
	201705-000	. I.C., Digital, 74HC14 ATTENTION	B	1
U2	200182-000	. I.C., Digital, 4013B ATTENTION		1
U3	200669-002	. I.C., Linear, LM339N		1
U4	201444-000	. I.C., Linear, LM358N, Op Amp		1
U5	200359-003	. I.C., Linear, MC1404U5, Voltage Reference		1
U6	200636-021	. I.C., Linear, +15V LM340, Voltage Regulator		1
U21	201646-000	. I.C., Digital, MCT210, Opto-Isolator		1
U22		. (Same As U1)	A	
	201727-000	. I.C., Digital, 74HC132 ATTENTION	B	1
U23	201830-000	. I.C., Digital, CD4024, Counter ATTENTION		2
U24	201469-000	. I.C., Digital, 74HC00, 2-Input ATTENTION	A	2
	201745-000	. I.C., Digital, 74HC51, And-Or Gate ATTENTION	B	1
U26	201242-000	. I.C., Digital, CD4047, Timer ATTENTION	A	2
		. (Same As U26)	B	1
U27	201588-000	. I.C., Digital, 74HC74, Dual D, Flip-Flop ATTENTION		1
U28,29	201611-000	. I.C., Digital, 74HC221, Multivibrator ATTENTION		2
U30		. (Same As U23)		
U32		. (Same As U24)	A	
	201469-000	. I.C., Digital, 74HC00, 4 NAND2 ATTENTION	B	1
U102		. (Same As U26)	A	

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-10				
	201774-000	. I.C., Digital, 74HC4538, Dual Multivibrator ATTENTION	B	1
U201	201659-000	. I.C., Linear, TBA820, Audio Amplifier		1
2	802893-00	. HEAT SINK, Charger, Monitor	A	1
	802893-01	. HEAT SINK, Charger, Monitor	B	1
3	801305-00	. INSULATOR, Silipad	A	1
4	201773-000	. RIVET, Semi-Tubular		2
5	200476-759	. SCREW, Pan Head, 4-40 X .187		1
6	200476-760	. SCREW, Pan Head, 4-40 X .250	A	7
	200476-760	. SCREW, Pan Head, 4-40 X .250	B	2
7	201110-260	. SCREW, Allen Head, 4-40 X .250	B	5
8	802868-02	. SHIELD, Monitor Power Supply	B	1
9	802888-02	. SHIELD, Power Supply	A	1
10	802888-04	. SHIELD, Power Supply	B	1
11	201575-002	. WASHER, Lock, #4 X .265 OD	B	3
12	200431-849	. WASHER, Shoulder, Nylon, Natural, #4 X .115 ID X .060		5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CR106
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Q21
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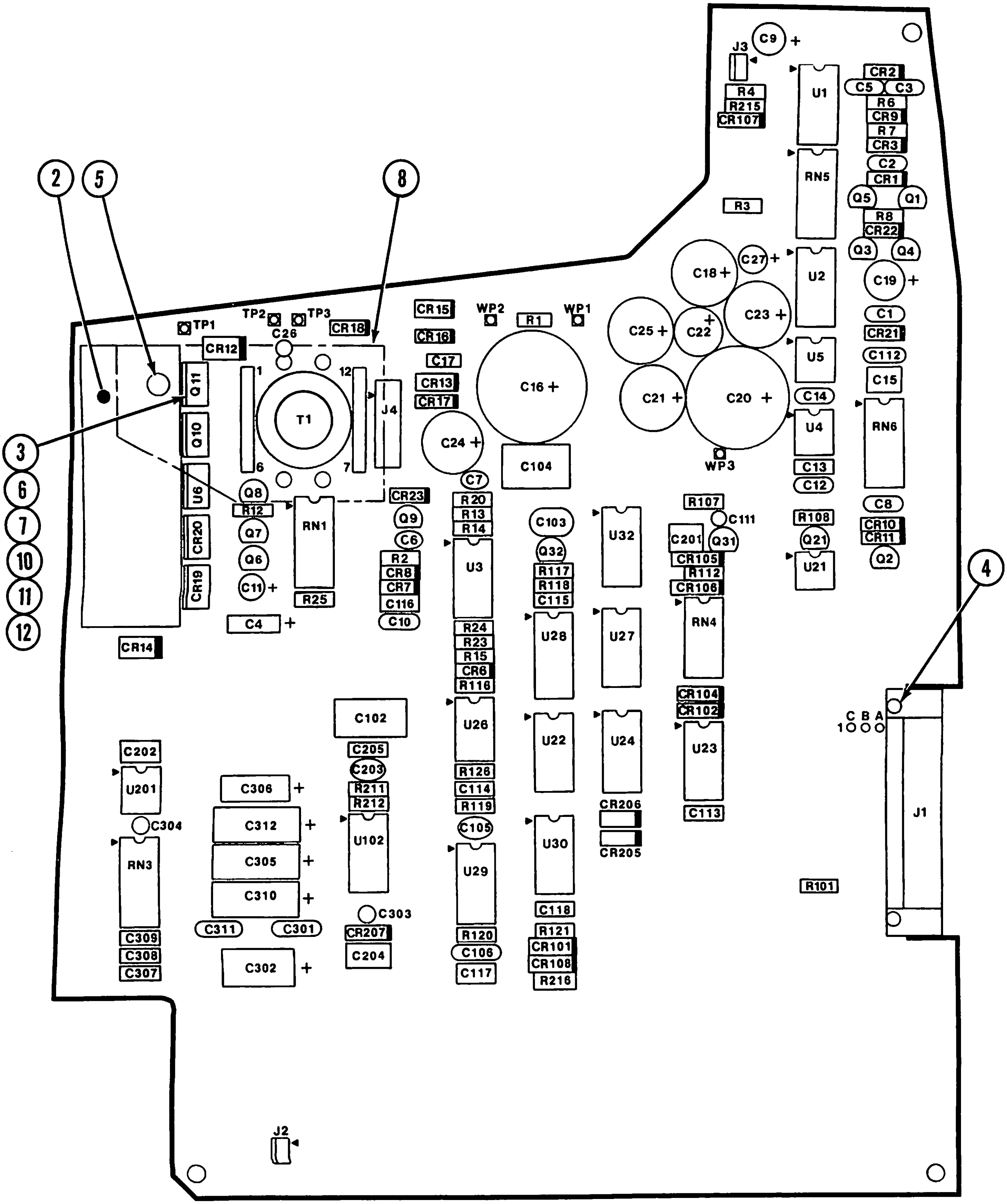
C308
C307
C311
C301
R214
R213
CR207
C118
R120
C106
C117
R121
CR101
CR108
R216
C302
J2

802815-02

FIGURE 5-10. POWER SUPPLY PCB ASSEMBLY (SHEET 1 OF 6)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R6
CR9
R7
CR3
C2
CR1
RN5
Q5
Q1
R3
R8
CR22
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R107
C111
C201
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CR105
R112
CR106
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C118
R121
CR101
CR108
R216
C309
C308
C307
C302
J2

802815-03

FIGURE 5-10. POWER SUPPLY PCB ASSEMBLY (SHEET 2 OF 6)

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-11				
A4	802833-03	ECG PCB ASSEMBLY	A	REF
	802833-05	ECG PCB ASSEMBLY	B	REF
C1-3	201628-078	. CAPACITOR, 1.0µF/50V, 10%		5
C4,5	200901-095	. CAPACITOR, 1nF/100V, 5%	A	11
	200901-016	. CAPACITOR, 33pF/50V, 5%	B	2
C6	200264-026	. CAPACITOR, 2.2µF/50V, 20%		1
C7		. (Same As C4)	A	
	200901-095	. CAPACITOR, 1nF/100V, 10%	B	9
C13,14		. (Same As C4)	A	
		. (Same As C7)	B	
C16,17	200500-038	. CAPACITOR, Tantalum, 10µF/25V, 20%		5
C18		. (Same As C4)	A	
		. (Same As C7)	B	
C19,20	201628-004	. CAPACITOR, 4.7nF/50V, 5%	A	4
	201628-004	. CAPACITOR, 4.7nF/50V, 5%	B	4
C22,23	201628-018	. CAPACITOR, 1µF/50V, 5%		4
C25	201628-074	. CAPACITOR, .22µF/50V, 10%		1
C27-30	200901-029	. CAPACITOR, 390pF/50V, 5%		4
C31,32	201628-072	. CAPACITOR, .10µF/50V, 10%		15
C33,34	201628-068	. CAPACITOR, 22nF/50V, 10%		2
C35	201628-015	. CAPACITOR, .33µF/50V, 5%		4
C36		. (Same As C31)		
C37	200901-022	. CAPACITOR, 100pF/50V, 5%		2
C38	200901-013	. CAPACITOR, 18pF/50V, 5%		1
C39	200901-011	. CAPACITOR, 12pF/50V, 5%		1
C40		. (Same As C31)		
C44-46		. (Same As C31)		
C47	200205-046	. CAPACITOR, Electrolytic, 2.2µF/50V, 10%		2
C48,49		. (Same As C16)		
C50	200701-013	. CAPACITOR, Electrolytic, 22µF/25V, 20%		1
C51-53		. (Same As C31)		
C54		. (Same As C16)		
C59,60		. (Same As C4)	A	
		. (Same As C7)	B	
C61		. (Same As C31)		
C62		. (Same As C19)		
C63,64		. (Same As C35)		
C65		. (Same As C1)		
C66		. (Same As C19)		
C68		. (Same As C31)		
C69,70	200893-006	. CAPACITOR, 470pF/50V, 10%		2
C71-73		. (Same As C31)		
C74	200753-176	. CAPACITOR, Tantalum, 150µF/25V, 20%		1
C75		. (Same As C1)		
C77-79		. (Same As C4)	A	
		. (Same As C7)	B	
C81		. (Same As C37)		
C82		. (Same As C47)		
C83		. (Same As C35)		
C84		. CAPACITOR, .022µF/50V, 5%	B	1
	201628-008	. CAPACITOR, .022µF/50V, 5%	B	1
C220,230		. (Same As C22)		
CR3	200510-001	. DIODE, Bridge, VE18X, 1 Amp		1
CR6,7, 9,10	200971-000	. DIODE, IN914B, 8nS, PIV 75		5
CR21	200177-000	. DIODE, Zener, P6KE6.8, 10mA/600W		1
CR22,23	200177-023	. DIODE, Zener, P6KE20A		2
CR26		. (Same As CR6)		
DS1-4	201695-000	. LED, Red, HLMP1700		5
DS5	201695-001	. LED, Yellow, HLMP1719		1
DS6		. (Same As DS1)		
J1	201292-006	. SOCKET, Strip, 6 Contact		1
J3	801050-02	. CONNECTOR, Plug, 6 Contact		1

PARTS LIST

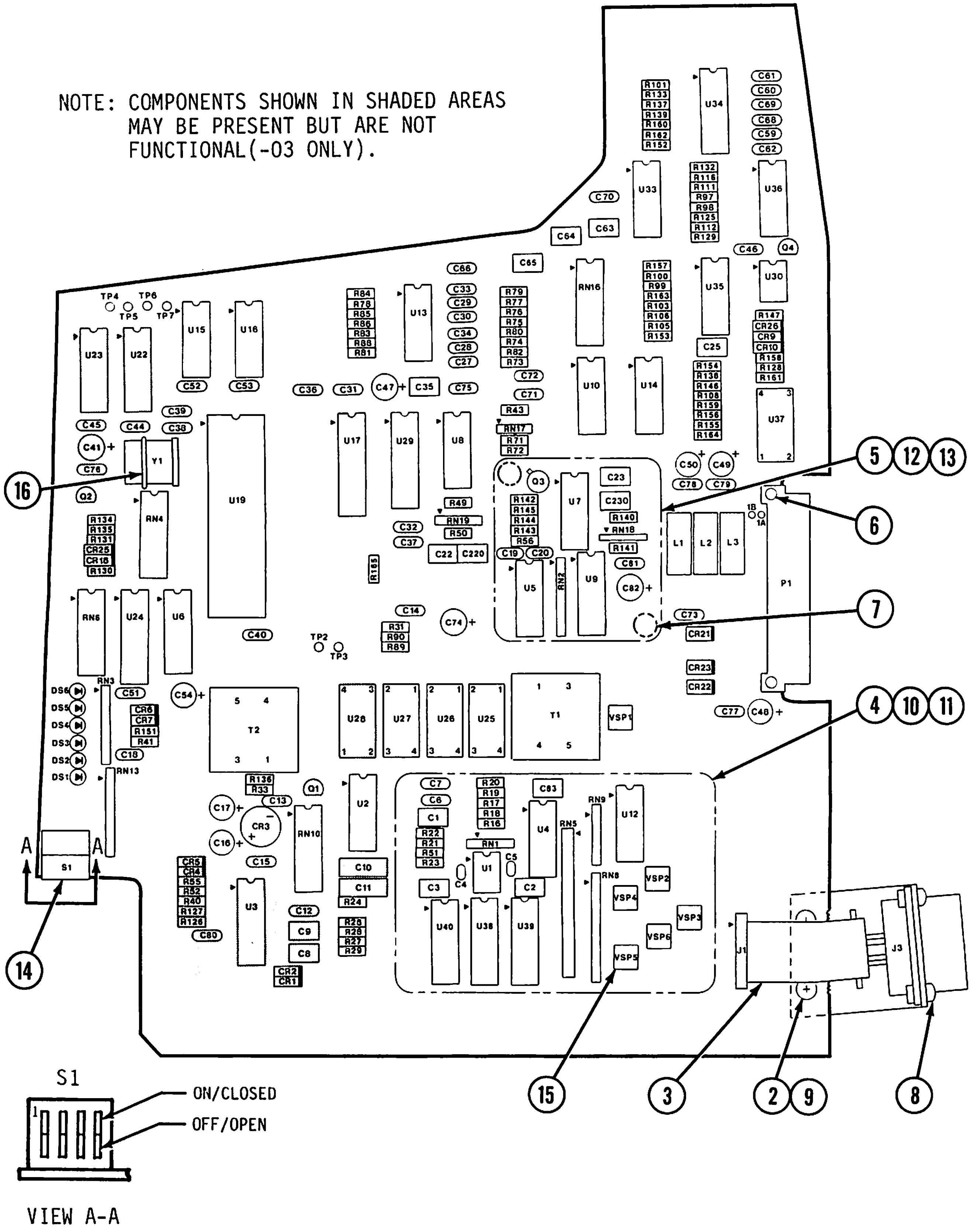
FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-11				
L1-3	200833-013	. INDUCTOR, 500µH		3
P1	201678-031	. CONNECTOR, Receptacle, 90°, 32 Contact		1
Q3	200582-001	. TRANSISTOR, FET, VCR4N		1
Q4	201738-001	. TRANSISTOR, P-Channel FET, VP0106N3 ATTENTION		1
R16	200054-576	. RESISTOR, 3.65 kΩ, 1/8W, 1%, RN55C	A	1
	200054-249	. RESISTOR, 3.92 kΩ, 1/8W, 1%, RN55C	B	1
R17,18	200054-317	. RESISTOR, 20 kΩ, 1/8W, 1%, RN55C		6
R19,20	200054-097	. RESISTOR, 100 Ω, 1/8W, 1%, RN55C		2
R21	200054-508	. RESISTOR, 2 MΩ, 1/8W, 1%, RN55C		4
R22	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C		11
R23	200054-238	. RESISTOR, 2.94 kΩ, 1/8W, 1%, RN55C		1
R24		. (Same As R22)		
R28	200054-346	. RESISTOR, 40.2 kΩ, 1/8W, 1%, RN55C		1
R29	200054-491	. RESISTOR, 1.33 MΩ, 1/8W, 1%, RN55C		1
R31	200054-480	. RESISTOR, 1 MΩ, 1/8W, 1%, RN55C		9
R41	200054-330	. RESISTOR, 27.4 kΩ, 1/8W, 1%, RN55C		1
R43	200054-165	. RESISTOR, 511 Ω, 1/8W, 1%, RN55C		1
R49		. (Same As R17)		
R50	200054-522	. RESISTOR, 2.80 MΩ, 1/8W, 1%, RN55C		1
R51	200054-426	. RESISTOR, 274 kΩ, 1/8W, 1%, RN55C		1
R56	200054-168	. RESISTOR, 549 Ω, 1/8W, 1%, RN55C		1
R71		. (Same As R17)		
R72	200054-375	. RESISTOR, 80.6 kΩ, 1/8W, 1%, RN55C		1
R73	200054-464	. RESISTOR, 681 kΩ, 1/8W, 1%, RN55C		2
R74	200054-435	. RESISTOR, 340 kΩ, 1/8W, 1%, RN55C		1
R75		. (Same As R73)		
R76		. (Same As R17)		
R77	200054-185	. RESISTOR, 825 Ω, 1/8W, 1%, RN55C		1
R78	200054-213	. RESISTOR, 1.62 kΩ, 1/8W, 1%, RN55C		1
R79,80	200054-334	. RESISTOR, 30.1 kΩ, 1/8W, 1%, RN55C		2
R81	200054-389	. RESISTOR, 113 kΩ, 1/8W, 1%, RN55C		1
R82	200054-364	. RESISTOR, 61.9 kΩ, 1/8W, 1%, RN55C		1
R83	200054-461	. RESISTOR, 634 kΩ, 1/8W, 1%, RN55C		1
R84		. (Same As R22)		
R85	200054-338	. RESISTOR, 33.2 kΩ, 1/8W, 1%, RN55C		1
R86	200054-355	. RESISTOR, 49.9 kΩ, 1/8W, 1%, RN55C		2
R88	200054-413	. RESISTOR, 200 kΩ, 1/8W, 1%, RN55C		1
R89,90	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C		4
R97	200054-345	. RESISTOR, 39.2 kΩ, 1/8W, 1%, RN55C		1
R98	200054-353	. RESISTOR, 47.5 kΩ, 1/8W, 1%, RN55C		1
R99,100	200054-300	. RESISTOR, 13.3 kΩ, 1/8W, 1%, RN55C		2
R101		. (Same As R21)		
R103		. (Same As R22)		
R105	200470-168	. RESISTOR, 10 MΩ, 1/8W, 1%, RN55C		1
R106		. (Same As R31)		
R108	200054-274	. RESISTOR, 7.15 kΩ, 1/8W, 1%, RN55C		1
R111		. (Same As R31)		
R112		. (Same As R17)		
R116	200054-259	. RESISTOR, 4.99 kΩ, 1/8W, 1%, RN55C		1
R125		. (Same As R31)		
R128, 129		. (Same As R31)		
R132		. (Same As R89)		
R133		. (Same As R31)		
R134		. (Same As R22)		
R136		. (Same As R31)		
R137	200054-139	. RESISTOR, 274 Ω, 1/8W, 1%, RN55C		2
R138		. (Same As R21)		
R139		. (Same As R31)		
R140	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C		6
R141	200054-434	. RESISTOR, 332 kΩ, 1/8W, 1%, RN55C		3
R142	200054-231	. RESISTOR, 2.49 kΩ, 1/8W, 1%, RN55C		1
R143, 144		. (Same As R141)		

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-11				
R145		. (Same As R89)		
R146		. (Same As R21)		
R147		. (Same As R137)		
R151	200470-080	. RESISTOR, 2.2 kΩ, 1/4W, 5%		1
R152		. (Same As R140)		
R153	200054-332	. RESISTOR, 28.7 kΩ, 1/8W, 1%, RN55C	A	1
	200054-307	. RESISTOR, 15.8 kΩ, 1/8W, 1%, RN55C	B	1
R154		. (Same As R140)		
R155-157		. (Same As R22)		
R158		. (Same As R86)		
R159		. (Same As R140)	A	
		. RESISTOR, 38.3 kΩ, 1/8W, 1%, RN55C	B	1
R160, 161		. (Same As R22)		
R162, 163		. (Same As R140)		
R164		. (Same As R22)		
R165	200054-114	. RESISTOR, 150 Ω, 1/8W, 1%, RN55C		1
R166		. (Same As R140)	B	
RN1	201425-004	. RESISTOR NETWORK, 20 kΩ, .1%, 2 Resistors		2
RN2	201425-018	. RESISTOR NETWORK, 20 kΩ, .1%, 4 Resistors		1
RN3	201240-018	. RESISTOR NETWORK, 4 X 100 kΩ, 5%, 8 Pin	A	1
	201240-040	. RESISTOR NETWORK, 4 X 15 kΩ, 1/3W, 2%, 8 Pin	B	1
RN4	200043-077	. RESISTOR NETWORK, 8 X 100 kΩ, 1.5W, 2%, 16 Pin		3
RN5	801962-00	. RESISTOR NETWORK, Wilson, 2 kΩ, .25%, 15 Pin		1
RN6	200043-032	. RESISTOR NETWORK, 8 X 470 kΩ, 1.5W, 2%, 16 Pin		1
RN8	803452-00	. RESISTOR NETWORK, 5 X 50 kΩ, 1%, 10 Pin		1
RN9	802837-00	. RESISTOR NETWORK, 4 X 10 MΩ, 1%, 5 Pin		1
RN10		. (Same As RN4)		
RN13	201240-012	. RESISTOR NETWORK, 4 X 10 kΩ, 5%, 8 Pin	A	1
	201240-033	. RESISTOR NETWORK, 4 X 1 kΩ, 2%, 8 Pin	B	1
RN16		. (Same As RN4)		
RN17	803553-00	. RESISTOR NETWORK, Precision, 511 Ω/260 kΩ, 1%, 3 Pin		1
RN18	803553-01	. RESISTOR NETWORK, Precision, 9.98 kΩ/510 kΩ, 1%, 4 Pin		1
RN19		. (Same As RN1)		
S1	201708-002	. SWITCH, DIP, Rocker, 76SB04		1
T1	802012-00	. TRANSFORMER		1
T2	803089-00	. TRANSFORMER		1
TP2-7	801959-00	. TERMINAL, Test Point		6
U1	200487-000	. I.C., Linear, LF353, Op Amp		2
U2	201214-002	. I.C., Linear, LF444A, Op Amp		7
U4	201342-050	. I.C., Linear, 303, Analog Switch ⚠ ATTENTION		4
U5	201342-040	. I.C., Linear, 307, Analog Switch ⚠ ATTENTION		1
U6	201126-000	. I.C., Linear, SG3525A, Pulse Width Modulator		1
U7,8		. (Same As U2)		
U9	201658-000	. I.C., Linear, DG211, Analog Switch ⚠ ATTENTION		1
U10		. (Same As U4)		
U12,13		. (Same As U2)		
U14		. (Same As U4)		
U15	201705-000	. I.C., Digital, 74HC14, Hex Schmidt ⚠ ATTENTION		1
U16	201615-000	. I.C., Digital, 74HC10, NAND Gate ⚠ ATTENTION		1
U17	201654-000	. I.C., Digital, 7528, Dual D/A Converter ⚠ ATTENTION		1
U19	802891-300	. I.C., Digital, Microcomputer 6301, Mask Programmed ⚠ ATTENTION		1
U24	201521-000	. I.C., Linear, UDN2981A, High Voltage Driver		1
U25-27	201597-000	. I.C., Linear, CNY65, Opto-Isolator		4
U29	201652-000	. I.C., Digital, 7574, A/D Converter ⚠ ATTENTION		1
U30		. (Same As U1)		
U33		. (Same As U2)		
U34	201140-000	. I.C., Digital, CD4046, Phase-Locked Loop ⚠ ATTENTION		1
U35		. (Same As U2)		
U36		. (Same As U4)		

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-11				
U37		. (Same As U25)		
U38-40	201743-000	. I.C., Linear, DG508A, Analog Switch		3
VSP1	200324-007	. VOLTAGE SURGE PROTECTOR, 2.5kVdc		1
VSP2-6	200324-001	. VOLTAGE SURGE PROTECTOR, 90Vdc, 1pF		5
XU1	200675-020	. SOCKET, DIP, 8 Pin		1
XU19	200675-029	. SOCKET, DIP, 40 Pin		1
XU34	200675-022	. SOCKET, DIP, 16 Pin		
Y1	200417-004	. CRYSTAL, Microprocessor, 4.000 mHz		1
2	802855-00	. BRACKET, Patient Connector		1
3	201846-001	. FLEX CABLE, 6 Conductor		1
4	803509-00	. INSULATOR, Isolated, Circuit Side		1
5	803510-00	. INSULATOR, Nonisolated, Circuit Side		1
6	201773-000	. RIVET, Semi-Tubular		2
7	200476-762	. SCREW, 4-40 X .437		4
8	200476-761	. SCREW, 4-40 X 5/16		3
9	200476-792	. SCREW, 6-32 X 1/4		2
10	804030-00	. SHIELD, Bracket, ECG Connector (Not Shown)	B	1
11	802817-00	. SHIELD, Coated, Isolated, Circuit Side		1
12	802824-00	. SHIELD, Coated, Isolated, Component Side		1
13	802825-00	. SHIELD, Coated, Nonisolated, Circuit Side		1
14	802816-00	. SHIELD, Coated, Nonisolated, Component Side		1
15	201724-000	. SOCKET, 90°, DIP, 8 Pin		1
15	201544-242	. TUBING, No Heat Shrink, .500 L		5
16	90-09138	. WIRE, Solid Bus, #22 AWG		A/R


①⑤ ①② ①③
⑥
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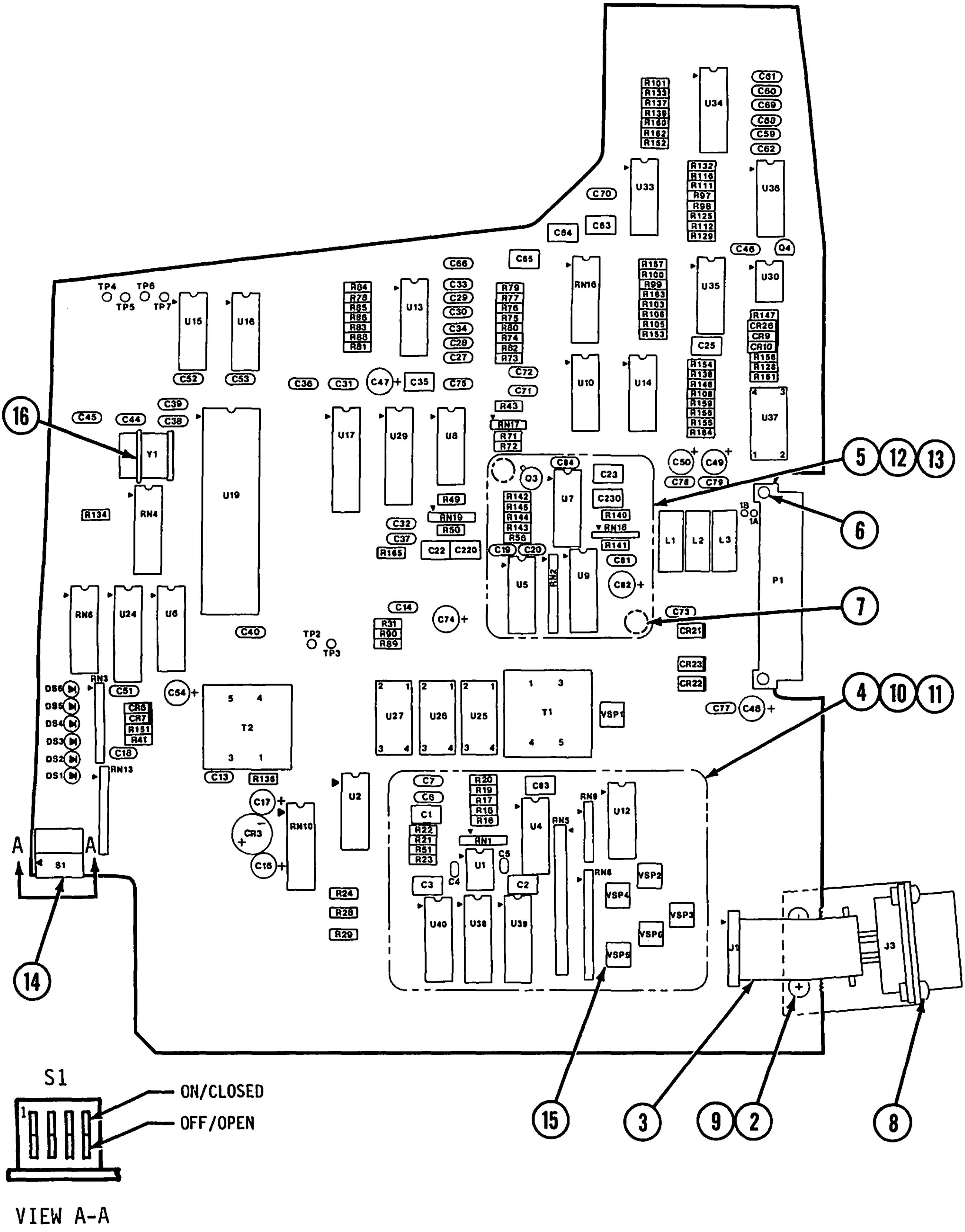
①⑤
③
② ⑨
⑧
S1
ON/CLOSED
OFF/OPEN
VIEW A-A
A
A
P1
J1
J3
T1
T2
U19
Y1
S1

NOTE: COMPONENTS SHOWN IN SHADED AREAS
MAY BE PRESENT BUT ARE NOT
FUNCTIONAL(-03 ONLY).

FIGURE 5-11. ECG PCB ASSEMBLY


16
5
12
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2
8
A
A
S1
ON/CLOSED
OFF/OPEN
VIEW A-A
U34
U33
U36
U35
U30
U37
RN16
U10
U14
U15
U16
U13
U17
U29
U8
U19
Y1
RN4
RN6
U24
U6
U7
U5
U9
RN2
L1
L2
L3
P1
Q3
Q4
T1
T2
U27
U26
U25
U2
RN10
CR3
U4
U12
U1
U40
U38
U39
RN1
RN5
RN8
RN9
VSP1
VSP2
VSP3
VSP4
VSP5
VSP6
J1
J3
TP2
TP3
TP4
TP5
TP6
TP7
DS1
DS2
DS3
DS4
DS5
DS6
RN3
RN13
RN17
RN18
RN19

FIGURE 5-11. ECG PCB ASSEMBLY

802833-05

PARTS LIST

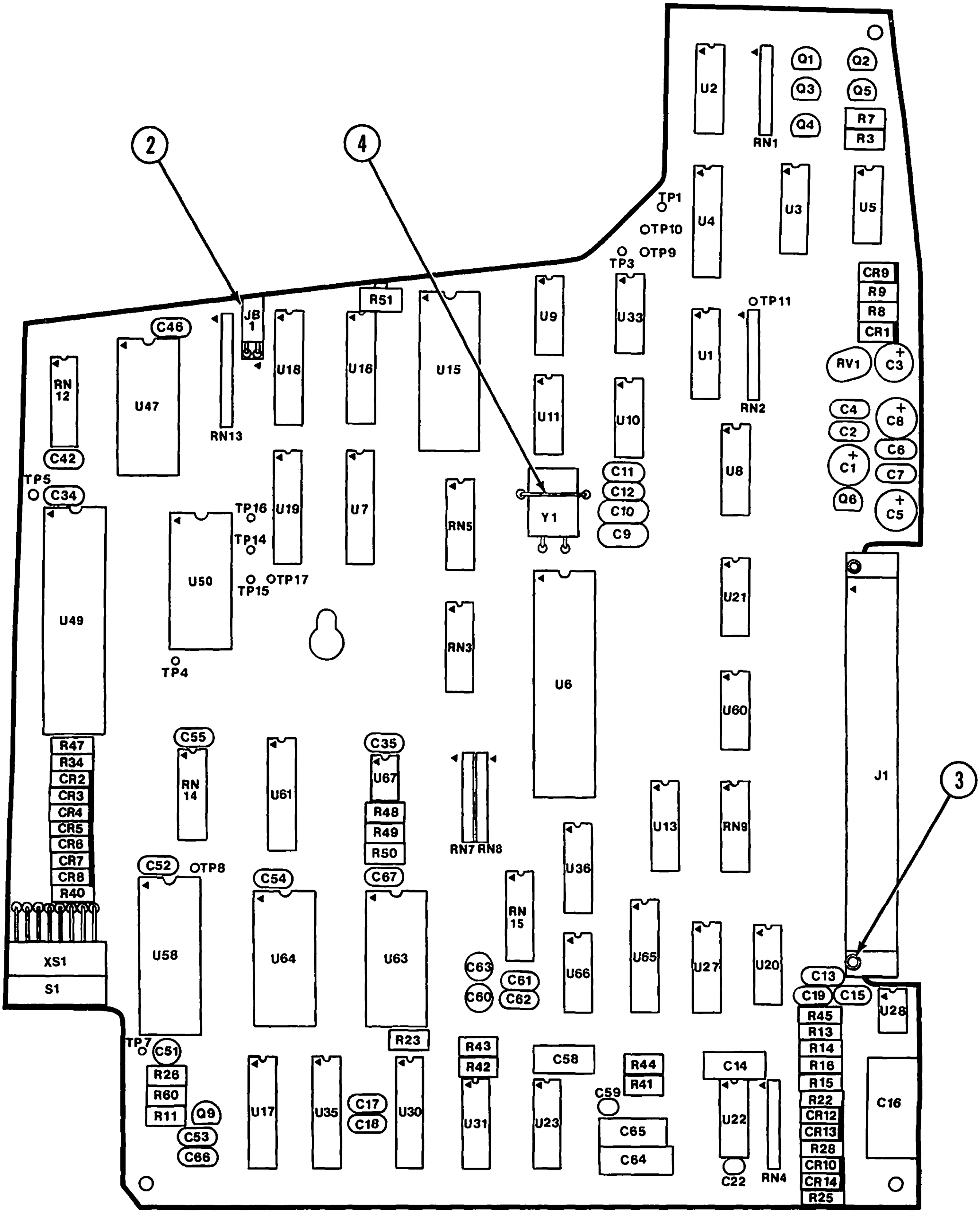
FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-12 A6	802827-04	CONTROL PCB ASSEMBLY		REF
C1	200205-025	. CAPACITOR, Electrolytic, 22µF/25V, 10%		4
C2	200893-034	. CAPACITOR, .10µF/50V, 10%		21
C3		. (Same As C1)		
C4		. (Same As C2)		
C5		. (Same As C1)		
C6,7		. (Same As C2)		
C8		. (Same As C1)		
C9	200274-004	. CAPACITOR, 8pF/500V, 5%		1
C10	200274-008	. CAPACITOR, 18pF/500V, 5%		1
C11-13		. (Same As C2)		
C14	200744-040	. CAPACITOR, .033µF/100V, 5%		1
C15	200901-043	. CAPACITOR, 5600pF/50V, 5%		1
C16	200744-021	. CAPACITOR, 2µF/50V, 5%		1
C17-19		. (Same As C2)		
C22	200893-070	. CAPACITOR, 3900pF/50V, 10%		1
C34,35, 42,46		. (Same As C2)		
C51	201628-078	. CAPACITOR, 1µF/50V, 10%		3
C52-55		. (Same As C2)		
C58	200274-040	. CAPACITOR, 390pF/500V, 5%		1
C59	200901-036	. CAPACITOR, 1500pF/50V, 5%		1
C60		. (Same As C51)		
C61,62		. (Same As C2)		
C63		. (Same As C51)		
C64	200744-011	. CAPACITOR, .33µF/50V, 5%		1
C65	200744-004	. CAPACITOR, .082µF/50V, 5%		1
C66		. (Same As C2)		
C67	200893-038	. CAPACITOR, .22µF/50V, 10%		1
CR1	200083-001	. DIODE, 1N5818, 1A/20V		1
CR2-8	200971-000	. DIODE, 1N914B, 8nS, PIV 75		8
CR9	200086-009	. DIODE, Zener, 1N4623, 4.3V, .2W, 5%, 65mA		1
CR10		. (Same As CR2)		
CR12-14	201372-000	. DIODE, 1N270, 200mA, PIV 80		3
J1	201678-028	. CONNECTOR, DIN, 64 Contact		1
JB1	201328-000	. CONNECTOR, Plug, 90°, 2 Contact		1
Q1-4	200888-001	. TRANSISTOR, PNP, PN2907A, TO-92		4
Q5	200942-001	. TRANSISTOR, NPN, PN2222A, TO-92		1
Q6,9	801233-01	. TRANSISTOR, PNP, PN2907A, TO-18		2
R3	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C		2
R7	200054-259	. RESISTOR, 4.99 kΩ, 1/8W, 1%, RN55C		1
R8	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C		5
R9	200054-316	. RESISTOR, 19.6 kΩ, 1/8W, 1%, RN55C		2
R11		. (Same As R3)		
R13	200054-426	. RESISTOR, 274 kΩ, 1/8W, 1%, RN55C		1
R14	200054-397	. RESISTOR, 137 kΩ, 1/8W, 1%, RN55C		1
R15	200054-432	. RESISTOR, 316 kΩ, 1/8W, 1%, RN55C		1
R16	200054-400	. RESISTOR, 147 kΩ, 1/8W, 1%, RN55C		1
R22,23, 25,26		. (Same As R8)		
R28	200054-231	. RESISTOR, 2.49 kΩ, 1/8W, 1%, RN55C		1
R34	200470-138	. RESISTOR, 560 kΩ, 1/4W, 5%		1
R40	200054-235	. RESISTOR, 2.74 kΩ, 1/8W, 1%, RN55C		1
R41	200054-297	. RESISTOR, 12.4 kΩ, 1/8W, 1%, RN55C		1
R42,43	200470-041	. RESISTOR, 51 Ω, 1/4W, 5%		2
R44	200054-243	. RESISTOR, 3.32 kΩ, 1/8W, 1%, RN55C		1
R45	200054-380	. RESISTOR, 90.9 kΩ, 1/8W, 1%, RN55C		1
R47	200470-112	. RESISTOR, 47 kΩ, 1/4W, 5%		1
R48	200054-221	. RESISTOR, 1.96 kΩ, 1/8W, 1%, RN55C		1
R49		. (Same As R9)		
R50	200054-312	. RESISTOR, 17.8 kΩ, 1/8W, 1%, RN55C		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-12				
R51	200503-008	. POTENTIOMETER, 5 kΩ, 1/2W, 20%, 1 Turn		1
R60	200470-114	. RESISTOR, 56 kΩ, 1/4W, 5%		1
RN1,2	201240-025	. RESISTOR NETWORK, 4 X 39 kΩ, 1/3W, 5%		3
RN3	200043-077	. RESISTOR NETWORK, 8 X 100 kΩ, 2%		1
RN4		. (Same As RN1)		
RN5	200043-056	. RESISTOR NETWORK, 7 X 4.7 kΩ, 1.1W, 2%		2
RN7	201240-012	. RESISTOR NETWORK, 4 X 10 kΩ, 1/3W, 5%		1
RN8	201240-014	. RESISTOR NETWORK, 4 X 22 kΩ, 1/3W, 5%		1
RN9	200043-065	. RESISTOR NETWORK, 8 X 10 kΩ, 1.5W, 2%		1
RN12	200043-020	. RESISTOR NETWORK, 8 X 150 Ω, 1.5W, 2%		1
RN13	200422-089	. RESISTOR NETWORK, 9 X 10 kΩ, 1.25W, 2%		1
RN14		. (Same As RN5)		
RN15	200423-136	. RESISTOR NETWORK, 8 X 10 kΩ, 1.75W, 1%		1
RV1	201251-240	. VARISTOR, Metal Oxide, 5.5V		1
S1	201708-006	. SWITCH, DIP, SPST, Rocker		1
TP1,3-5, 7-11, 14-17	801959-00	. TERMINAL, Test Point		13
U1	200045-000	. I.C., Interface CD4053BCN, Multiplexer/ Demultiplexer ATTENTION		2
U2	201609-000	. I.C., Digital, 74HC138, Decoder ATTENTION		2
U3	201387-000	. I.C., Linear, ULN2003, Transistor Array ATTENTION		1
U4	201610-000	. I.C., Digital, 74HC245, Transceiver ATTENTION		3
U5	201685-000	. I.C., 74HC125, Buffer ATTENTION		2
U6	802891-01	. I.C., Digital, HD6303, Microprocessor ATTENTION		1
U7		. (Same As U4)		
U8		. (Same As U2)		
U9	201606-000	. I.C., Digital, 74HC73, Flip-Flop ATTENTION		1
U10	201458-000	. I.C., Digital, 74HC04, Hex Inverter		1
U11	201607-000	. I.C., Digital, 74HC32, OR Gate		2
U13	201658-000	. I.C., Digital, DG211CJ, Switch		2
U15	803453-106	. I.C., Digital, 27C64, 64K EPROM		1
U16	201510-000	. I.C., Digital, 74HC373, Latch		2
U17	201638-000	. I.C., Digital, 74HC374, Flip-Flop		3
U18		. (Same As U16)		
U19		. (Same As U4)		
U20	201577-000	. I.C., Digital, 74HC08, AND Gate		1
U21		. (Same As U11)		
U22	201214-003	. I.C., Linear, LF444, Op Amp		2
U23		. (Same As U13)		
U27	201313-000	. I.C., Digital, 4020, Counter ATTENTION		1
U28	200359-003	. I.C., Linear, 1404, Precision Low Voltage Reference ATTENTION		1
U30	201594-001	. I.C., Digital, ADC0805, A/D Converter ATTENTION		1
U31	201614-000	. I.C., Digital, 74HC175, Flip-Flop ATTENTION		1
U33	201745-000	. I.C., Digital, 74HC51, Inverter/Gate		1
U35		. (Same As U17)		
U36		. (Same As U1)		
U47	802486-02	. I.C., Digital, UP446-2C, Static RAM, 2k X 8 ATTENTION		3
U49	803105-00	. I.C., Digital, Gate Array, Controller, Raster ATTENTION		1
U50	802892-00	. I.C., Digital, CDP1834CE, Character ROM ATTENTION		1
U58	802846-02	. I.C., Digital, Gate Array, No Fade		1
U60		. (Same As U5)		
U61		. (Same As U17)		
U63,64		. (Same As U47)		
U65	201654-000	. I.C., Digital, 7528, Buffered DAC Multiplying D/A Converter ATTENTION		1
U66		. (Same As U22)		
U67	201444-000	. I.C., Linear, LM358N, Op Amp		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-12				
XS1	201724-002	. SOCKET, 16-822-90E		1
XU6	200675-029	. SOCKET, I.C., 40 Pin		2
XU15	200675-026	. SOCKET, I.C., 28 Pin		2
XU49		. (Same As XU6)		
XU50	200675-025	. SOCKET, I.C., 24 Pin		1
XU58		. (Same As XU15)		
Y1	200417-004	. CRYSTAL, Microprocessor, 4.000 MHz		1
2	201176-000	. CONNECTOR, Receptacle, Jumper, 2 Contact		1
3	201773-000	. RIVET, Semi-Tubular		2
4	90-09138	. WIRE, Bus, #22 AWG		A/R


2
4
3
U2
RN1
Q1
Q2
Q3
Q5
Q4
R7
R3
TP1
U4
U3
U5
OTP10
OTP9
TP3
CR9
R9
R8
CR1
OTP11
R51
JB 1
C46
U18
U16
U15
U9
U33
U1
RN2
RV1
C3
RN 12
U47
RN13
U11
U10
C4
C8
C2
U8
C6
C1
C7
C42
TP5
C34
C11
C12
C10
C9
Y1
Q6
C5
TP16
U19
U7
RN5
TP14
U50
OTP17
TP15
U49
RN3
U21
TP4
U6
U60
J1
C55
C35
RN 14
U61
U67
R47
R34
CR2
CR3
CR4
CR5
CR6
CR7
CR8
R40
R48
R49
R50
RN7
RN8
U13
RN9
U36
C52
OTP8
C54
C67
U58
U64
U63
RN 15
U65
U27
U20
XS1
S1
C63
C61
U66
C13
C60
C62
C19
C15
U28
R45
R13
R14
R16
R15
R22
CR12
CR13
R28
CR10
CR14
R25
TP7
C51
R23
R43
R42
C58
R44
R41
C14
C16
R26
R60
R11
Q9
U17
U35
C17
C18
U30
U31
U23
C59
C65
C64
U22
C22
RN4
C53
C66

802827

FIGURE 5-12. CONTROL PCB ASSEMBLY
(SHEET 1 OF 5)

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-13 A5	802835-03	GATEWAY PCB ASSEMBLY	A	REF
	802835-04	GATEWAY PCB ASSEMBLY	B	REF
	802835-05	GATEWAY PCB ASSEMBLY	C	REF
C1-6	200049-039	. CAPACITOR, .1µF/50V, 20%	A	8
		. (Same As C1)	B	10
C7		. (Same As C1)	B	
C8,9		. (Same As C1)		
C10		. (Same As C1)	B	
C11	200204-012	. CAPACITOR, 47µF/10V, 50%	B	1
C12	200893-210	. CAPACITOR, 1nF/50V, 20%	C	1
C17,18	200274-008	. CAPACITOR, 18pF/500V, 5%		2
CR1,2	201749-002	. DIODE, Zener, SA11, 11V		2
CR3	201749-006	. DIODE, Zener, SA11C, 11V		1
CR4	201749-005	. DIODE, Zener, SA6.5C, 6.5V		1
CR5	200177-000	. DIODE, Zener, P6KE6.8	B	1
CR6	200971-000	. DIODE, 1N914B, PIV 75	C	1
J1	201678-031	. CONNECTOR, Male, 90%, 32 Pin		1
L1	200833-013	. INDUCTOR, 500µH, 500mA	B	1
R1	200054-164	. RESISTOR, 499 Ω, 1/8W, 1%, RN55C	C	1
R19	200054-250	. RESISTOR, 4.02 kΩ, 1/8W, 1%, RN55C		1
R20	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%		2
R21	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%		1
R22		. (Same As R20)		
RN1	200176-065	. RESISTOR NETWORK, 7 X 10 kΩ		2
RN2	802792-00	. RESISTOR NETWORK, Custom, 8 Multi Value Resistors		1
RN3		. (Same As RN1)		
S1	201708-004	. SWITCH, DIP Rocker, 6-SPST		1
TP1-7	801959-00	. TERMINAL, Test Point		7
U1	802891-01	. I.C., Digital, HD6303, Microprocessor		1
U2,3	201681-000	. I.C., Digital, HD6350, UART		2
U4	803453-205	. I.C., Digital, 27C64, EPROM		1
U6	201510-000	. I.C., Digital, 74HC373, Latch ⚠ ATTENTION		1
U7	201610-000	. I.C., Digital, 74HC245, Transceiver	B	1
U8	201609-000	. I.C., Digital, 74HC138, Decoder, Demultiplexer		1
U11	200487-000	. I.C., Linear, LF353, Op Amp		1
U13	201635-000	. I.C., Digital, 74HC4020, 14 Stage Divider (Counter) ⚠ ATTENTION		1
U14	201699-000	. I.C., Linear, 74C914, Extended Input Schmidt Trigger ⚠ ATTENTION		1
U16	201458-000	. I.C., Digital, 74HC04, Hex Inverter ⚠ ATTENTION		1
U17	201497-000	. I.C., Digital 74LS08, AND Gate ⚠ ATTENTION		1
U18	201641-000	. I.C., Digital, 74HC76, Flip-Flop ⚠ ATTENTION		1
U19	201469-000	. I.C., Digital, 74HC00, NAND Gate ⚠ ATTENTION		1
XU1	200907-026	. SOCKET, DIP, 40 Contact		1
XU4	200907-025	. SOCKET, DIP, 28 Contact		1
Y1	200417-004	. CRYSTAL, 4.000 MHz, Microprocessor		1
2	201773-000	. RIVET, Semi-Tubular, 11/32 L		2
3	201301-130	. WIRE, Jumper, #22 AWG, .550 L		1

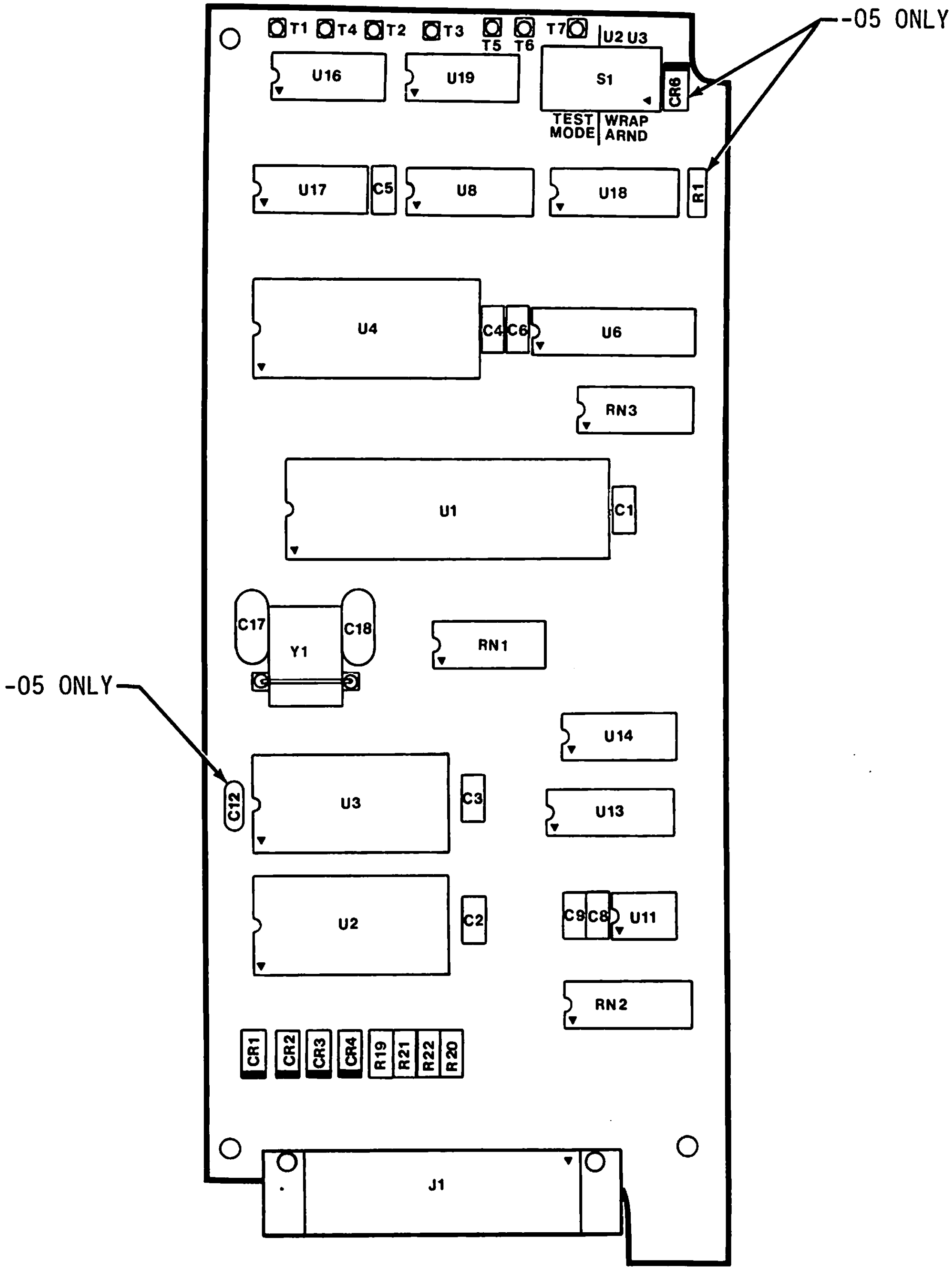

-05 ONLY
T1
T4
T2
T3
T5
T6
T7
U2 U3
U16
U19
S1
CR6
TEST MODE
WRAP ARND
U17
C5
U8
U18
R1
U4
C4
C6
U6
RN3
U1
C1
C17
Y1
C18
RN1
-05 ONLY
U14
C12
U3
C3
U13
U2
C2
C9
C8
U11
RN2
CR1
CR2
CR3
CR4
R19
R21
R22
R20
J1

FIGURE 5-13. GATEWAY PCB ASSEMBLY 802835-04,-05
(SHEET 1 OF 3)

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-14				
A7	802831-02	CRT PCB ASSEMBLY	A	REF
	802831-03	CRT PCB ASSEMBLY	B	REF
C1,2	200049-039	. CAPACITOR, .1µF/50V, 20%		22
C3	200744-017	. CAPACITOR, 1.0µF/50V, 5%		1
C4-6		. (Same As C1)		
C7	200701-031	. CAPACITOR, Electrolytic, 10µF/50V, 100%		1
	200701-040	. CAPACITOR, Electrolytic, 10µF/63V, 100%	B	1
C8		. (Same As C1)		
C9	200507-026	. CAPACITOR, .005µF/1kV, 25V		1
C10	200274-042	. CAPACITOR, 470pF/500V, 5%		1
C11	200901-205	. CAPACITOR, 150pF/100V, 10%	A	2
		. (Same as C11)	B	1
C12	200744-040	. CAPACITOR, .033µF, 100V, 5%		1
C13	200893-271	. CAPACITOR, 4700pF/100V, 20%		1
C15-19		. (Same As C1)		
C20	200205-038	. CAPACITOR, Electrolytic, 100µF/35V, 10%		3
C21-26		. (Same As C1)		
C27		. (Same As C20)		
C28		. (Same As C1)		
C29		. (Same As C20)		
C30	200701-051	. CAPACITOR, Electrolytic, 10µF/100V, 100%		1
C31,32	200205-052	. CAPACITOR, Electrolytic, 47µF/50V, 10%		3
C33,34	200701-000	. CAPACITOR, Electrolytic, 47µF/10V, 100%	A	2
	200701-007	. CAPACITOR, Electrolytic, 47µF/100V, 100%	B	2
C35		. (Same As C31)		
C47,48		. (Same As C1)		
C49	200901-095	. CAPACITOR, 1000pF/100V, 5%		2
C100	200049-000	. CAPACITOR, 56pF/50V, 2%		1
C101, 102		. (Same As C1)		
C103	200546-147	. CAPACITOR, Tantalum, 1µF/50V, 10%		1
C104	200901-108	. CAPACITOR, .012µF/100V, 5%		1
C105	200901-097	. CAPACITOR, 1500pF/100V, 5%		1
C110		. (Same As C49)		
C111		. (Same As C11)	A	
	200901-083	. CAPACITOR, 100pF/100V, 5%	B	2
C112	200893-063	. CAPACITOR, 1000pF/100V, 10%	A	1
C113	200893-091	. CAPACITOR, .22µF/100V	B	1
C114		. (Same As C111)	B	
CR1,2	200971-000	. DIODE, 1N914B, 8nS, PIV 75		12
CR3	200445-000	. I.C., Linear, Voltage Reference, LM329B, 6-9V, TO-92		1
CR4	200284-001	. DIODE, 1N4001, 1A, PIV 50		1
CR5	200658-002	. DIODE, MR812, 200nS, PIV 200		4
CR8,9		. (Same As CR1)		
CR11	200927-000	. DIODE, Zener, 1N821, 7.5mA/6.2V		1
CR12	200083-001	. DIODE, 1N5818, 1A/30V		2
CR13	200083-000	. DIODE, 1N5817, 1A/20V		1
CR14		. (Same As CR5)		
CR15	200083-002	. DIODE, 1N5819, 1A/40V	A	1
	200088-005	. DIODE, PH51102, 2A/100V	B	1
CR17		. (Same As CR12)		
CR20,21	200086-019	. DIODE, Zener, 1N4104, 24.8mA/10V		2
CR22-26		. (Same As CR1)		
CR27	200605-017	. DIODE, Zener, 1N4745A, 285mA/16V		1
CR35,36		. (Same As CR5)		
CR37	200177-053	. DIODE, Zener, P6KE82A, 1mA		1
CR38		. (Same As CR1)		
CR39	200271-012	. DIODE, Zener, 1N3518, 10mA/10V		1
CR41	200086-041	. DIODE, Zener, 1N4126, 51V		1
CR42,43		. (Same As CR1)		
CR44	200605-000	. DIODE, Zener, 1N4728A, 1380mA/3.3V	B	1
CR45		. (Same As CR5)	B	1
J2	200096-002	. CONNECTOR, Plug, Locking, 4 Contact		1
J3	200096-003	. CONNECTOR, Plug, Locking, 5 Contact		1
J4	200096-004	. CONNECTOR, Plug, Locking, 6 Contact		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-14				
JB1	200397-004	. CONNECTOR, Header, DIP, 10 Contact		1
L2-5	200833-012	. INDUCTOR, RF, 250 µH, 800 mA		4
L6	200808-000	. INDUCTOR, Ferrite Bead (Not Shown)	B	1
P1	201678-031	. CONNECTOR, DIN, Male, 90°, 32 Contact		1
Q1	201200-000	. TRANSISTOR, PFET, P1087E, TO-106		1
Q2	200621-000	. TRANSISTOR, PNP, D45H11, TO-220		3
Q3	201268-000	. TRANSISTOR, NPN, D44H11, TO-220		3
Q4	200617-001	. TRANSISTOR, VFET, D45D2, TO-220		3
Q5	200791-000	. TRANSISTOR, NPN, 2N3903, TO-92		5
Q7	200613-005	. TRANSISTOR, NFET, VN99AB, TO-39		1
Q8	201738-002	. TRANSISTOR, VFET, VP0109N3, TO-92		1
Q9	200585-003	. TRANSISTOR, VFET, VN0109N3, TO-92		1
Q10	200585-001	. TRANSISTOR, VFET, VN0106N3, TO-92		9
Q11	200883-000	. TRANSISTOR, PNP, 2N3905, TO-92		2
Q12		. (Same As Q5)		
Q13,14		. (Same As Q10)		
Q15		. (Same As Q3)		
Q16		. (Same As Q2)		
Q17		. (Same As Q5)		
Q18,19		. (Same As Q4)		
Q20		. (Same As Q11)		
Q21	200986-000	. TRANSISTOR, NPN, PN2484, TO-92		1
Q22,23		. (Same As Q10)		
Q24		. (Same As Q3)		
Q25		. (Same As Q2)		
Q26	200942-001	. TRANSISTOR, NPN, PN2222A, TO-92		2
Q27	200888-001	. TRANSISTOR, PNP, VCEO 60, PN2907A, TO-18		2
Q28		. (Same As Q5)		
Q31-34		. (Same As Q10)		
Q40		. (Same As Q26)		
Q41		. (Same As Q5)		
Q42		. (Same As Q27)		
Q43	201891-000	. TRANSISTOR, NPN, 2N4410, TO-92		1
R3	201794-008	. POTENTIOMETER, 5 kΩ, 1/2W, 20%, 1 Turn	A	2
	200527-031	. POTENTIOMETER, 5 kΩ, 1/2W, 10%, Multi-Turn	B	2
R5	201794-011	. POTENTIOMETER, 50 kΩ, 1/2W, 20%, 1 Turn	A	1
	200527-031	. POTENTIOMETER, 50 kΩ, 1/2W, 10%, Multi-Turn	B	1
R13	201794-009	. POTENTIOMETER, 10 kΩ, 1/2W, 20%, 1 Turn	A	2
	200527-008	. POTENTIOMETER, 10 kΩ, 1/2W, 10%, Multi-Turn	B	1
R14		. (Same As R3)		
R16-18	200054-097	. RESISTOR, 100 Ω, 1/8W, 1%, RN55C		7
R19	200054-199	. RESISTOR, 1.15 kΩ, 1/8W, 1%, RN55C		1
R20	200124-028	. RESISTOR, 15 Ω, 1/2W, 5%		1
R21	200054-139	. RESISTOR, 274 Ω, 1/8W, 1%, RN55C		1
R22	200216-018	. RESISTOR, 1 Ω, 1W, 1%		1
R23	200054-292	. RESISTOR, 11 kΩ, 1/8W, 1%, RN55C		1
R27	200054-235	. RESISTOR, 2.74 kΩ, 1/8W, 1%, RN55C		1
R28	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C		2
R29	200054-452	. RESISTOR, 511 kΩ, 1/8W, 1%, RN55C	A	1
	200054-452	. RESISTOR, 511 kΩ, 1/8W, 1% RN55C	B	2
R30	200124-055	. RESISTOR, 200 Ω, 1/2W, 5%		1
R31	201794-007	. POTENTIOMETER, 2 kΩ, 1/2W, 20%, 1 Turn	A	1
	200527-026	. POTENTIOMETER, 2 kΩ, 1/2W, 10%, Multi-Turn	B	1
R32	200054-480	. RESISTOR, 1 mΩ, 1/8W, 1%, RN55C		2
R33	200054-317	. RESISTOR, 20 kΩ, 1/8W, 1%, RN55C		1
R36	201794-012	. POTENTIOMETER, 100 kΩ, 1/2W, 20%, 1 Turn	A	2
	200527-033	. POTENTIOMETER, 200 kΩ, 1/2W, 10%, Multi-Turn	B	1
R37	200054-222	. RESISTOR, 2 kΩ, 1/8W, 1%, RN55C		4
R38	200054-272	. RESISTOR, 6.81 kΩ, 1/8W, 1%, RN55C		2
R39	200054-305	. RESISTOR, 15 kΩ, 1/8W, 1%, RN55C		1
R40		. (Same As R36)	A	
	200527-032	. POTENTIOMETER, 100 kΩ, 1/2W, 10%, Multi-Turn	B	1
R44	200054-173	. RESISTOR, 619 Ω, 1/8W, 1%, RN55C		1
R45	200054-114	. RESISTOR, 150 Ω, 1/8W, 1%, RN55C		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-14				
R46	201142-003	. POTENTIOMETER, 100 Ω, 1/2W, 20%, 1 Turn		1
R47	200216-002	. RESISTOR, .2 Ω, 1 W, 1%		2
R52		. (Same As R13)		
R54	200470-089	. RESISTOR, 5.1 kΩ, 1/4W, 5%	A	1
	200054-234	. RESISTOR, 2.67 kΩ, 1/8W, 1%, RN55C	B	1
R56	200054-413	. RESISTOR, 200 kΩ, 1/8W, 1%, RN55C		1
R60		. (Same As R16)		
R65		. (Same As R37)		
R66	200054-209	. RESISTOR, 1.47 kΩ, 1/8W, 1%, RN55C		1
R67	200054-161	. RESISTOR, 464 Ω, 1/8W, 1%, RN55C	A	1
	200054-155	. RESISTOR, 402 Ω, 1/8W, 1%, RN55C	B	1
R68	201794-005	. POTENTIOMETER, 500 Ω, 1/2W, 10%, 1 Turn		1
	200527-024	. POTENTIOMETER, 500 Ω, 1/2W, 10%, Multi-Turn	B	1
R69,70	200054-001	. RESISTOR, 10 Ω, 1/8W, 1%, RN55C		3
R73	200054-257	. RESISTOR, 4.75 kΩ, 1/8W, 1%, RN55C		1
R75		. (Same As R16)		
R76	200054-089	. RESISTOR, 82.5 Ω, 1/8W, 1%, RN55C	A	2
	200216-116	. RESISTOR, 56.2 Ω, 1W, 1%	B	1
R77		. (Same As R47)		
R90		. (Same As R69)		
R91		. (Same As R76)		
R93,94	200470-000	. RESISTOR, 1 Ω, 1/4W, 5%		2
R100		. (Same As R37)		
R101	200257-041	. RESISTOR, 510 Ω, 2W, 5%		1
R102	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C		1
R106		. (Same As R28)		
R107		. (Same As R37)		
R111, 112		. (Same As R16)		
R114		. (Same As R32)		
R120-122	200054-158	. RESISTOR, 432 Ω, 1/8W, 1%, RN55C		3
R123		. (Same As R38)		
R124, 125	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C		2
R126-130	200470-011	. RESISTOR, 3 Ω, 1/4W, 5%	B	6
R131	200054-260	. RESISTOR, 5.11 kΩ, 1/8W, 1%, RN55C	B	1
R132		. (Same As R29)	B	
R133		. (Same As R126)	B	
R134	200054-280	. RESISTOR, 8.25 kΩ, 1/8W, 1%, RN55C	B	1
RN1,2	200423-012	. RESISTOR NETWORK, 8 X 10 kΩ, .5W, 1%		2
RN3	201240-024	. RESISTOR NETWORK, 4 X 3.9 kΩ, 1/3W, 5%		1
RN4,5	802792-08	. RESISTOR NETWORK, Custom		2
RN6	802792-09	. RESISTOR NETWORK, Custom		1
RN7	802792-25	. RESISTOR NETWORK, Custom		1
RN8	802792-11	. RESISTOR NETWORK, Custom		1
TP1-9	801959-00	. TERMINAL, Test Point		9
U1	201214-003	. I.C., Linear, LF444, Op Amp, Quad, 14-P PL Dip ATTENTION		2
U2	800741-00	. I.C., Digital, CD4053, Multiplexer/Demultiplexer		1
U3	200254-000	. I.C., Linear, LF335N, Op Amp		1
U4		. (Same As U1)		
U5	200487-000	. I.C., Linear, LF353, Op Amp, J FET, Dual		2
U8	200627-000	. I.C., Linear, LF257H, Op Amp, JFET, TO-99		1
U9		. (Same As U5)		
2	201176-000	. CONNECTOR, Receptacle, Jumper, 2 Contact (Used on JB1)		5
3	201773-000	. FASTENER RIVET (Used On P1)		2
4	201726-000	. FASTENER, Chassis, #6-32		1
5	802894-00	. HEAT SINK, CRT		1
6	802305-02	. INSULATOR, Silipad, 7 Transistor, TO-220		1
7	802305-03	. INSULATOR, Silipad, 2 Transistor, TO-220		1
8	200476-760	. SCREW, Machine, Pan Head, 4-40 X .250 L		11
9	200431-849	. WASHER SHOULDER, Nylon, #4 X .115 ID X .060 T		9

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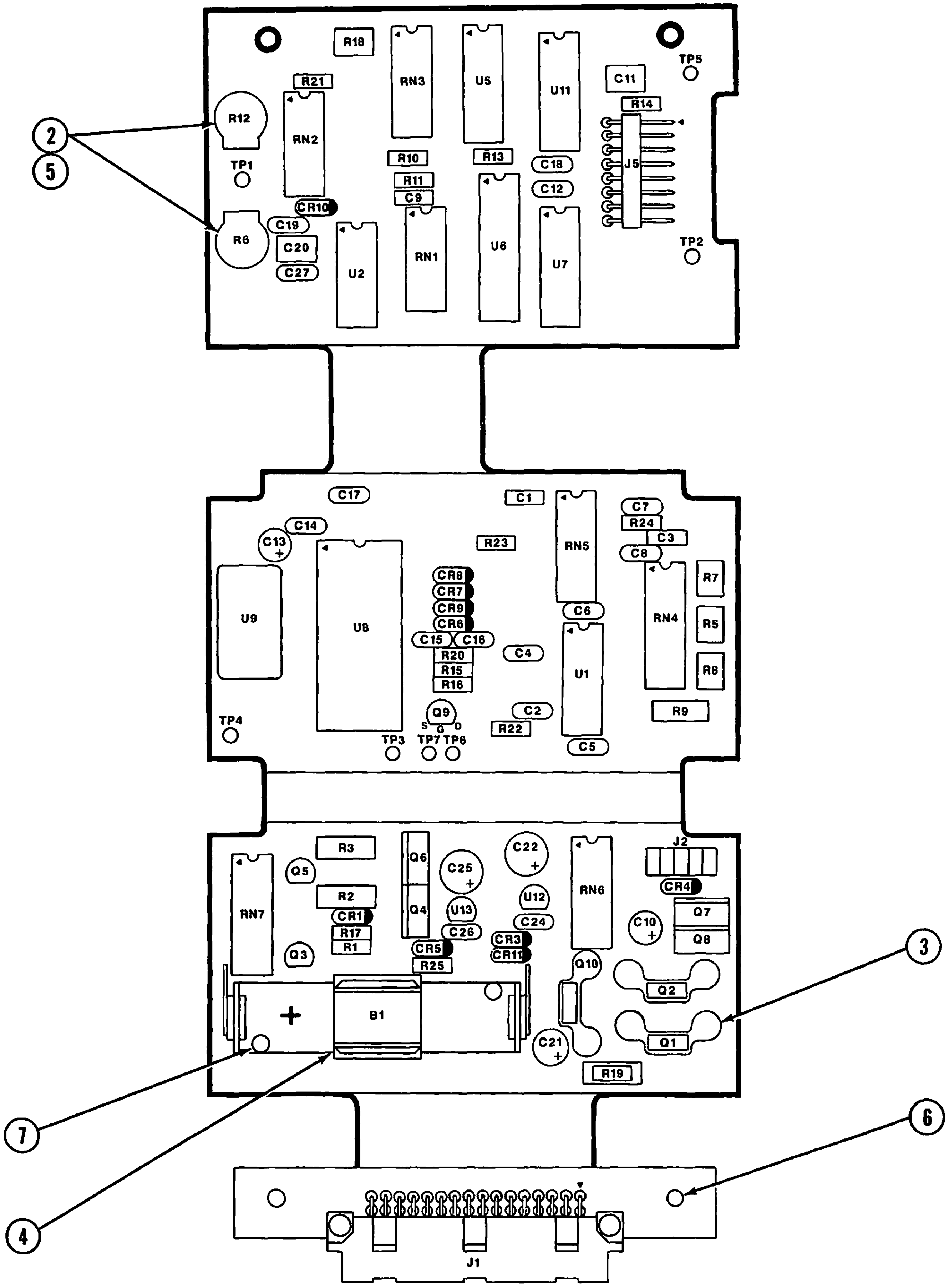
PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-16A				
A9	802819-04	RECORDER PFC ASSEMBLY, MFE	A	REF
	802819-05	RECORDER PFC ASSEMBLY, MFE	B	REF
	802819-06	RECORDER PFC ASSEMBLY, MFE	C	REF
B1	201757-000	. BATTERY, 3.5V, Li/SOCL2, Sub AA		1
C1	201628-010	. CAPACITOR, .047µF/50V, 5%		1
C2	200893-219	. CAPACITOR, .0056µF/50V, 20%		2
C3	201628-007	. CAPACITOR, .015µF/50V, 5%		1
C4,5	200893-034	. CAPACITOR, .10µF/50V, 10%		5
		. (Same As C4)	B,C	7
C6	200893-010	. CAPACITOR, 1000pF/50V, 10%		2
C7	200893-240	. CAPACITOR, 20%, .33µF/50V		1
C8		. (Same As C2)		
C9	200049-009	. CAPACITOR, 330pF, 20%		1
C10	200280-053	. CAPACITOR, 10µF/35V, 10%		1
C11	201628-015	. CAPACITOR, .33µF/50V, 5%		2
C12		. (Same As C4)		
C13	200205-034	. CAPACITOR, Electrolytic, 4.7µF/35V, 10%		2
C14		. (Same As C4)		
C15,16	200893-022	. CAPACITOR, .01µF/50V, 10%	A,B	2
	200893-022	. CAPACITOR, .01µF/50V, 10%	C	3
C17	200893-206	. CAPACITOR, 470pF/50V, 20%		1
C18	201628-006	. CAPACITOR, .01µF/50V, 5%		1
C19		. (Same As C6)		
C20		. (Same As C11)		
C21		. (Same As C13)		
C22	200205-028	. CAPACITOR, Electrolytic, 100µF/25V, 10%		1
C23		. (Same As C4)	A	
C24		. (Same As C4)	B,C	
C25	200701-013	. CAPACITOR, 22µF/25V, 20%	B,C	1
C26,27		. (Same As C4)	B,C	
C28,29		. (Same As C4)	C	2
C30		. (Same As C15)	C	
CR1	200971-000	. DIODE, 1N914B, 8ns, PIV 75	A,B	7
	200971-000	. DIODE, 1N914B, 8ns, PIV 75	C	9
CR2	200086-011	. DIODE, 1N4625, Zener, .2W, 55mA, 5.1V	A	1
CR3		. (Same As CR1)		
CR4	200658-000	. DIODE, MR810, 200ns, PIV 200		2
CR5	201272-000	. DIODE, 1N3595, 500mA, PIV 100	A	1
	200991-000	. DIODE, 1N5711, 15mA	B,C	1
CR6-10		. (Same As CR1)		
CR11		. (Same As CR4)		
CR13,14		. (Same As CR1)	C	
CR15	201749-001	. DIODE, SA6.5	C	1
J1	201678-031	. CONNECTOR, DIN, 32 Contact		1
J2	200397-004	. CONNECTOR, Plug, PCB, DIP, 10 Contact		1
J5	201542-078	. CONNECTOR, Male, 90°, 8 Contact		1
L1	201409-036	. INDUCTOR, 100µH, 345mA	C	1
Q1	201784-000	. TRANSISTOR, NPN, 2N5191, TO-126		1
Q2	201783-000	. TRANSISTOR, PNP, 2N5194, TO-126		1
Q3	200888-001	. TRANSISTOR, PNP, PN2907A, TO-92		1
Q4	201268-000	. TRANSISTOR, NPN, D44H11, TO-220		1
Q5	200791-001	. TRANSISTOR, NPN, 2N3904, TO-92		2
Q6	200621-000	. TRANSISTOR, PNP, D45H11, TO-220		1
Q7	200617-001	. TRANSISTOR, PNP, D45D2, TO-220		1
Q8	200616-001	. TRANSISTOR, NPN, D44D2, TO-220		1
Q9	200585-001	. TRANSISTOR, VFET, VN0106N3, TO-92 ⚠		1
Q10	201415-000	. TRANSISTOR, 2N6037 ATTENTION		1
Q11		. (Same As Q5)		
R1	200470-095	. RESISTOR, 9.1 kΩ, 1/4W, 5%		1
R2	200578-093	. RESISTOR, 750 Ω, 1W, 5%		1
R3	200578-089	. RESISTOR, 510 Ω, 1W, 5%		1


R18
RN3
U5
U11
TP5
C11
R21
R14
R12
RN2
J5
TP1
R10
R13
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R11
C12
C9
CR10
C19
R6
C20
C27
U2
RN1
U6
U7
TP2
2
5
C17
C1
C7
C14
R24
C13
C3
R23
RN5
C8
CR8
CR7
CR9
CR6
U9
U8
R7
C6
RN4
R5
C15
C16
C4
R20
R15
R16
U1
R8
Q9
C2
R9
TP4
S
G
D
TP3
TP7
TP6
R22
C5
R3
C22
J2
Q6
C25
Q5
RN6
CR4
R2
U12
RN7
Q4
U13
Q7
CR1
C24
C10
R17
C26
Q8
R1
CR5
CR3
CR11
Q3
R25
Q10
3
Q2
B1
+
Q1
C21
R19
7
6
4
J1

FIGURE 5-16A RECORDER PFC ASSEMBLY, MFE 802819-05
(SHEET 3 OF 5)

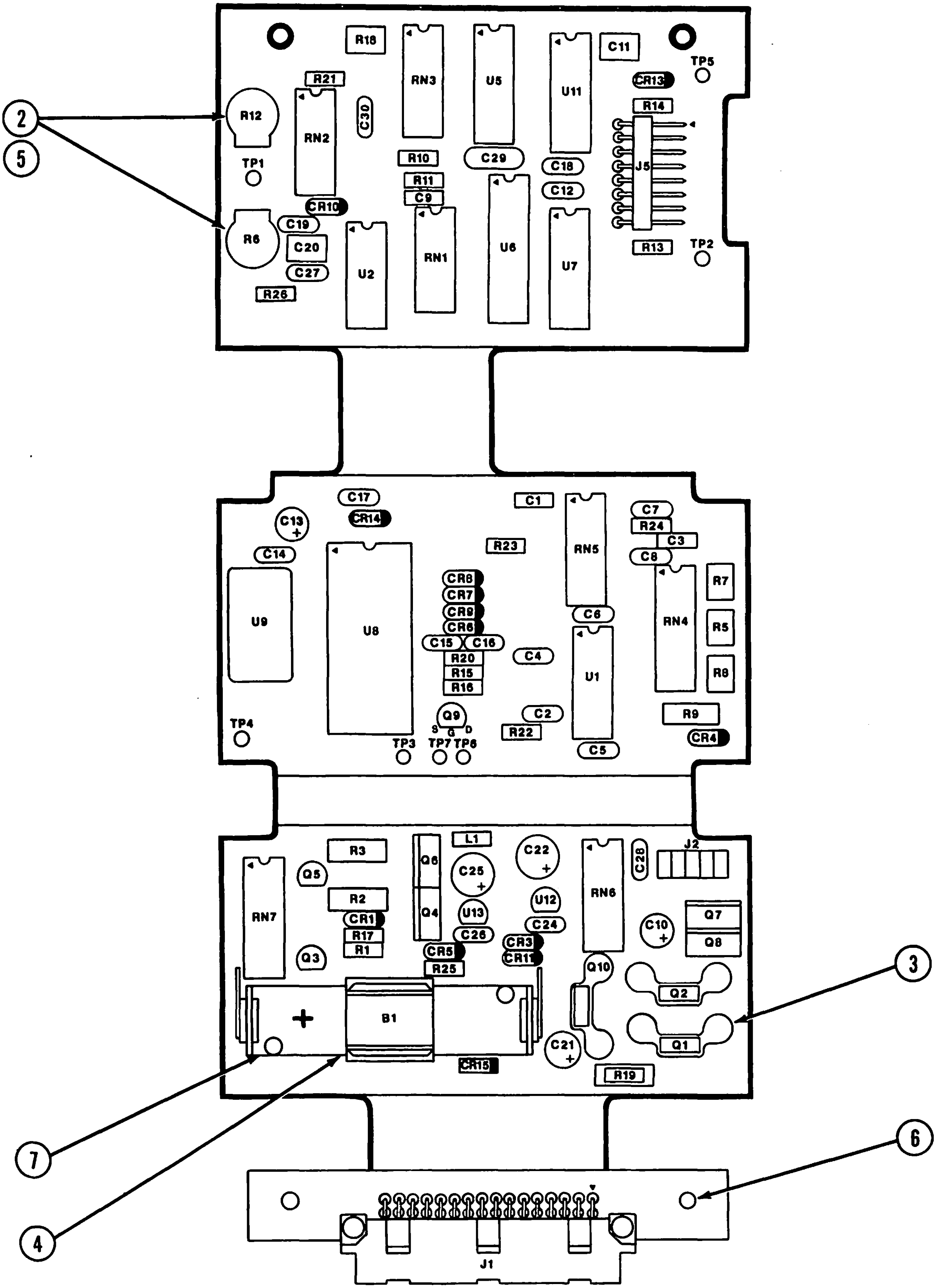
R18
RN3
U5
U11
C11
TP5
R21
CR13
R14
R12
RN2
C30
J5
TP1
R10
C29
C18
R11
C12
C9
CR10
C19
R6
C20
U2
RN1
U6
U7
R13
TP2
C27
R26
C17
C1
C7
C13
CR14
R24
C3
C14
R23
RN5
C8
R7
CR8
CR7
RN4
U9
CR9
C6
R5
U8
CR6
C15
C16
C4
R20
R15
U1
R8
R16
Q9
C2
R9
S
G
D
TP4
R22
CR4
TP3
TP7
TP6
C5
L1
J2
R3
C22
Q6
C28
C25
Q5
RN6
RN7
R2
U12
Q7
Q4
U13
CR1
C24
C10
R17
C26
CR3
Q8
R1
CR5
CR11
Q3
R25
Q10
Q2
B1
Q1
C21
CR15
R19
J1
2
5
3
7
6
4

FIGURE 5-16A RECORDER PFC ASSEMBLY, MFE (SHEET 4 OF 5)

802819-06

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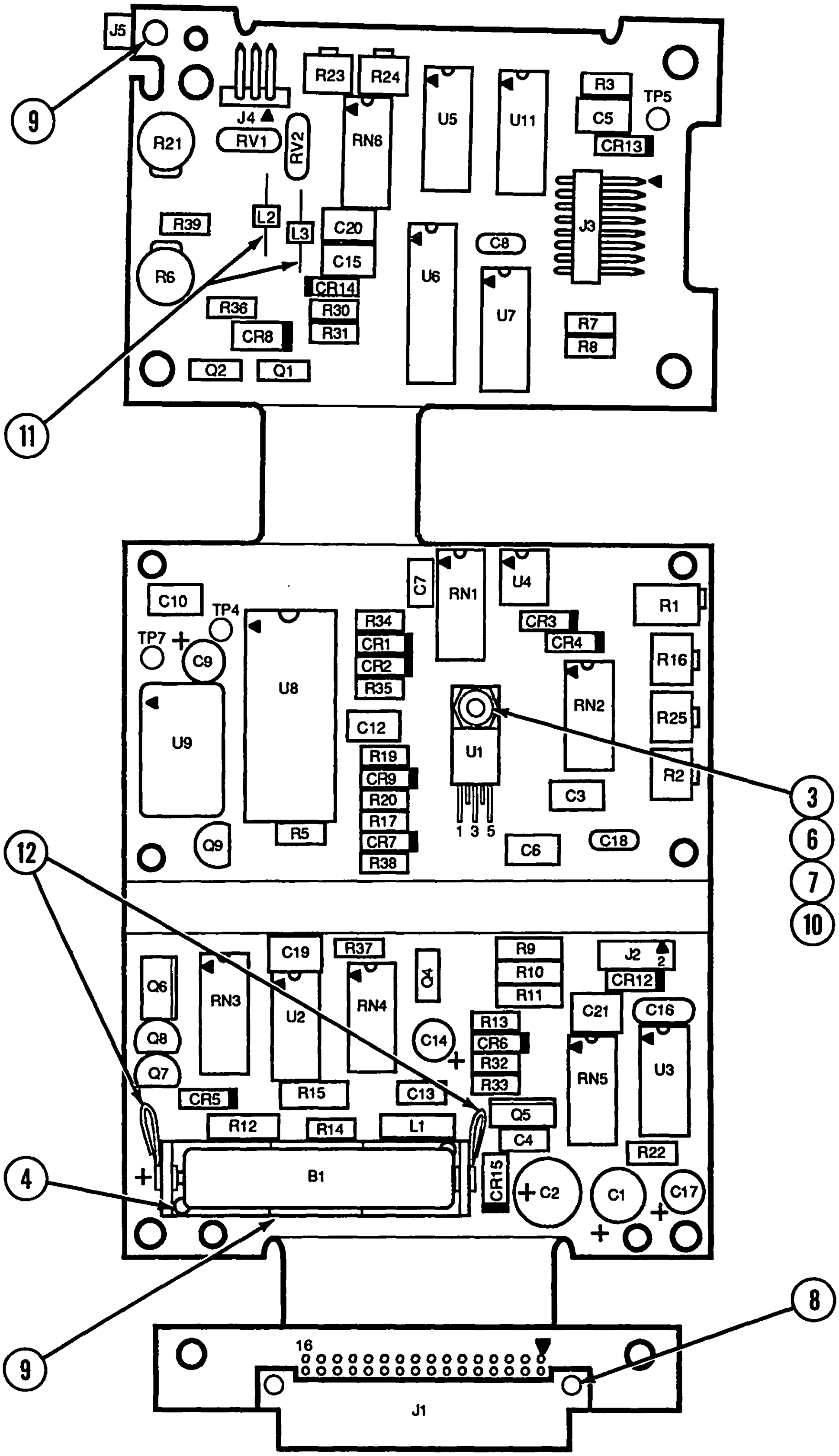
PARTS LIST

FIG-ITEM	PART NUMBER	1 2 3 4 5 6 7 DESCRIPTION	USE CODE	QTY
5-16B				
A9	802811-01	. RECORDER PFC ASSEMBLY, GSI		REF
B1	201757-000	. BATTERY, 3.5V, LI/SOC12, Sub A A		1
C1	200205-034	. CAPACITOR, Electrolytic, 4.7µF/35V, 10%		2
C2	200205-028	. CAPACITOR, Electrolytic, 100µF/25V, 10%		1
C3	201628-012	. CAPACITOR, .10µF/50V, 5%		5
C4	200966-010	. CAPACITOR, .047µF/50V, 5%		1
C5	201628-015	. CAPACITOR, .33µF/50V, 5%		1
C6	201628-014	. CAPACITOR, .22µF/50V, 5%		1
C7	201628-009	. CAPACITOR, .033µF/250V, 5%		1
C8	200893-034	. CAPACITOR, .10µF/50V, 10%		1
C9		. (Same As C1)		
C10		. (Same As C3)		
C12	201628-006	. CAPACITOR, .01µF/50V, 5%		1
C13	200049-009	. CAPACITOR, 330pF/50V, 20%		1
C14	200280-053	. CAPACITOR, 10µF/35V, 10%		1
C15	201628-016	. CAPACITOR, .47µF/50V		1
C16	200264-020	. CAPACITOR, .22µF/50V, 20%		2
C17	200500-021	. CAPACITOR, 1µF/35V, 20%		1
C18		. (Same As C16)		
C19-21		. (Same As C3)		
CR1,2	200971-000	. DIODE, IN914B, 8ns, PIV 75		6
CR3,4	200086-011	. DIODE, Zener, 1N4625, 55mA, 5.1V, .2W, 5%		3
CR5		. (Same As CR1)		
CR6		. (Same As CR3)		
CR7		. (Same As CR1)		
CR8	200658-000	. DIODE, MR802, 200ns, PIV 200		2
CR9	200991-000	. DIODE, Shottky, 1N5711, 15mA		1
CR11		. (Same As CR1)		
CR12		. (Same As CR8)		
CR13,14		. (Same As CR1)		
CR15	201749-001	. DIODE, Zener, SSA6.5		1
J1	201678-031	. CONNECTOR, DIN, 32 Contact		1
J2	200397-004	. CONNECTOR, Plug, DIP, 10 Contact		1
J3	201542-078	. CONNECTOR, Male, 90°, 8 Contact		1
J4	200892-001	. CONNECTOR, Male, 90°, 3 Contact		1
J5	804494-00	. SPRING, Ground Strap		1
L1	201409-036	. INDUCTOR, Shielded, 100µH		1
L2,3	200808-000	. INDUCTOR, Ferrite Bead		2
Q1	201411-000	. TRANSISTOR, PNP, 2N6034, TO-126		2
Q2	201415-000	. TRANSISTOR, NPN, 2N6037, TO-126		1
Q4		. (Same As Q1)		
Q5	200621-000	. TRANSISTOR, PNP, D45H11, TO-220		1
Q6	201268-000	. TRANSISTOR, NPN, D44H11, TO-220		1
Q7	200888-001	. TRANSISTOR, PNP, PN2907A, TO-92		1
Q8	200791-001	. TRANSISTOR, NPN, SN3904, TO-92		1
Q9	200585-001	. TRANSISTOR, VFET, VN0106N3, TO-92 ⚠ ATTENTION		1
R1	200527-009	. POTENTIOMETER, 10 kΩ, 1/2W, 10%		1
R2	201142-009	. POTENTIOMETER, 10 kΩ, 1/2W, 20%		1
R3	200054-302	. RESISTOR, 14 kΩ, 1/8W, 1%, RN55C		1
R4	200054-281	. RESISTOR, 8.45 kΩ, 1/8W, 1%, RN55C		1
R5	200054-417	. RESISTOR, 221 kΩ, 1/8W, 1%, RN55C		1
R6	200285-022	. POTENTIOMETER, 10 kΩ		1
R7	200054-307	. RESISTOR, 15.8 kΩ, 1/8W, 1%, RN55C		1
R8	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C		1
R9	200124-060	. RESISTOR, 330 Ω, 1/2W, 5%		1
R10,11	200471-000	. RESISTOR, 1 Ω, 1/2W, 5%		2
R12	200578-089	. RESISTOR, 510 Ω, 1W, 5%		1
R13	200054-185	. RESISTOR, 825 Ω, 1/8W, 1%, RN55C		1
R14	200054-284	. RESISTOR, 9.09 kΩ, 1/8W, 1%, RN55C		1
R15	200578-093	. RESISTOR, 750 Ω, 1W, 5%		1
R16	201142-007	. POTENTIOMETER, 2 kΩ, 1/2W, 20%		2
R17	200054-164	. RESISTOR, 499 Ω, 1/8W, 1%, RN55C		2
R19	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C		3
R20	200054-097	. RESISTOR, 100Ω, 1/8W, 1%, RN55C		1
R21	200285-029	. POTENTIOMETER, 100 kΩ, .15W, 30%		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-16B				
R22	200054-173	. RESISTOR, 619 Ω, 1/8W, 1%, RN55C		1
R23	201142-008	. POTENTIOMETER, 5 kΩ, 1/2W, 20%		1
R24		. (Same As R16)		
R25	201142-012	. POTENTIOMETER, 100 kΩ, 1/2W, 20%		1
R30	200054-367	. RESISTOR, 66.5 kΩ, 1/8W, 1%, RN55C		1
R31	200054-376	. RESISTOR, 82.5 kΩ, 1/8W, 1%, RN55C		1
R32	200054-380	. RESISTOR, 90.9 kΩ, 1/8W, 1%, RN55C		1
R33,34		. (Same As R19)		
R35		. (Same As R17)		
R36	200054-309	. RESISTOR, 16.5 kΩ, 1/8W, 1%, RN55C		1
R37	200054-260	. RESISTOR, 5.11 kΩ, 1/8W, 1%, RN55C		1
R38	200054-352	. RESISTOR, 46.4 kΩ, 1/8W, 1%, RN55C		1
R39	200054-399	. RESISTOR, 143 kΩ, 1/8W, 1%, RN55C		1
RN1	802792-02	. RESISTOR NETWORK, Custom, 7 Multi-Value		1
RN2	802792-03	. RESISTOR NETWORK, Custom, 7 Multi-Value		1
RN3	802792-04	. RESISTOR NETWORK, Custom, 8 Multi-Value		1
RN4	802792-05	. RESISTOR NETWORK, Custom, 7 Multi-Value		1
RN5	802792-06	. RESISTOR NETWORK, Custom, 7 Multi-Value		1
RN6	802792-07	. RESISTOR NETWORK, Custom, 7 Multi-Value		1
RV1,2	201251-000	. VARISTOR, 18V, 250A		2
TP4,5, 7	801959-00	. TERMINAL, Test Point		3
U1	202119-000	. I.C., Linear, LM675T, Power Op Amp		1
U2	200669-002	. I.C., Linear, LM339N, Comparator		1
U3	200875-000	. I.C., Linear, LM2917, Converter, Frequency/Voltage		1
U4	201486-000	. I.C., Linear, LF442, Op Amp		1
U5	201589-000	. I.C., DG243, Analog Switch ⚠ ATTENTION		1
U6	201638-000	. I.C., Digital, 74HC374, Flip-Flop ⚠ ATTENTION		1
U7	201387-007	. I.C., Linear, ULN2013A, Transistor Array		1
U8	201463-000	. I.C., Digital, 146818, Time Clock ⚠ ATTENTION		1
U9	201687-000	. I.C., Oscillator, Crystal, Low Power, 32.768 kHz ⚠ ATTENTION		1
U11	201611-000	. I.C., Digital, 74HC221, Multivibrator ⚠ ATTENTION		1
2	200842-000	. ADHESIVE, Loctite 414 (Used with R6,12) (Not Shown)		A/R
3	202091-012	. HEAT SINK, U-Shape, AL, 6070B		1
4	201766-002	. HOLDER, Battery, PCB, Sub AA		1
5	800593-00	. GUIDE, Adjustment (Used with R6,21) (Not Shown)		2
6	800814-02	. INSULATOR, Thermal Conductive		1
7	90-03019	. NUT, Hex, Kep, 4-40 X .250W/.098T		1
8	201773-000	. RIVET, Semi-Tubular, Aluminum, .087 X .343 L		3
9	201773-002	. RIVET, Semi-Tubular, Aluminum, .087 X .125		3
10	200431-849	. WASHER, Shoulder, Nylon, Natural, #4 X .115ID X .060T		1
11	201301-123	. WIRE, Jumper		A/R
12	201301-624	. WIRE, Jumper		A/R


J5
9
J4
R23
R24
RN6
U5
U11
R3
C5
TP5
CR13
R21
RV1
RV2
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L3
C20
C15
CR14
R39
R6
U6
C8
U7
J3
R36
R30
R31
CR8
R7
R8
Q2
Q1
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C10
TP4
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C9
U8
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R35
C7
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CR4
R1
R16
RN2
R25
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CR9
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C18
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R2
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R10
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CR6
R32
R33
RN5
U3
Q7
CR5
R15
C13
Q5
R12
R14
L1
C4
R22
B1
CR15
C2
C1
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J1

FIGURE 5-16B RECORDER PFC ASSEMBLY, GSI 802811

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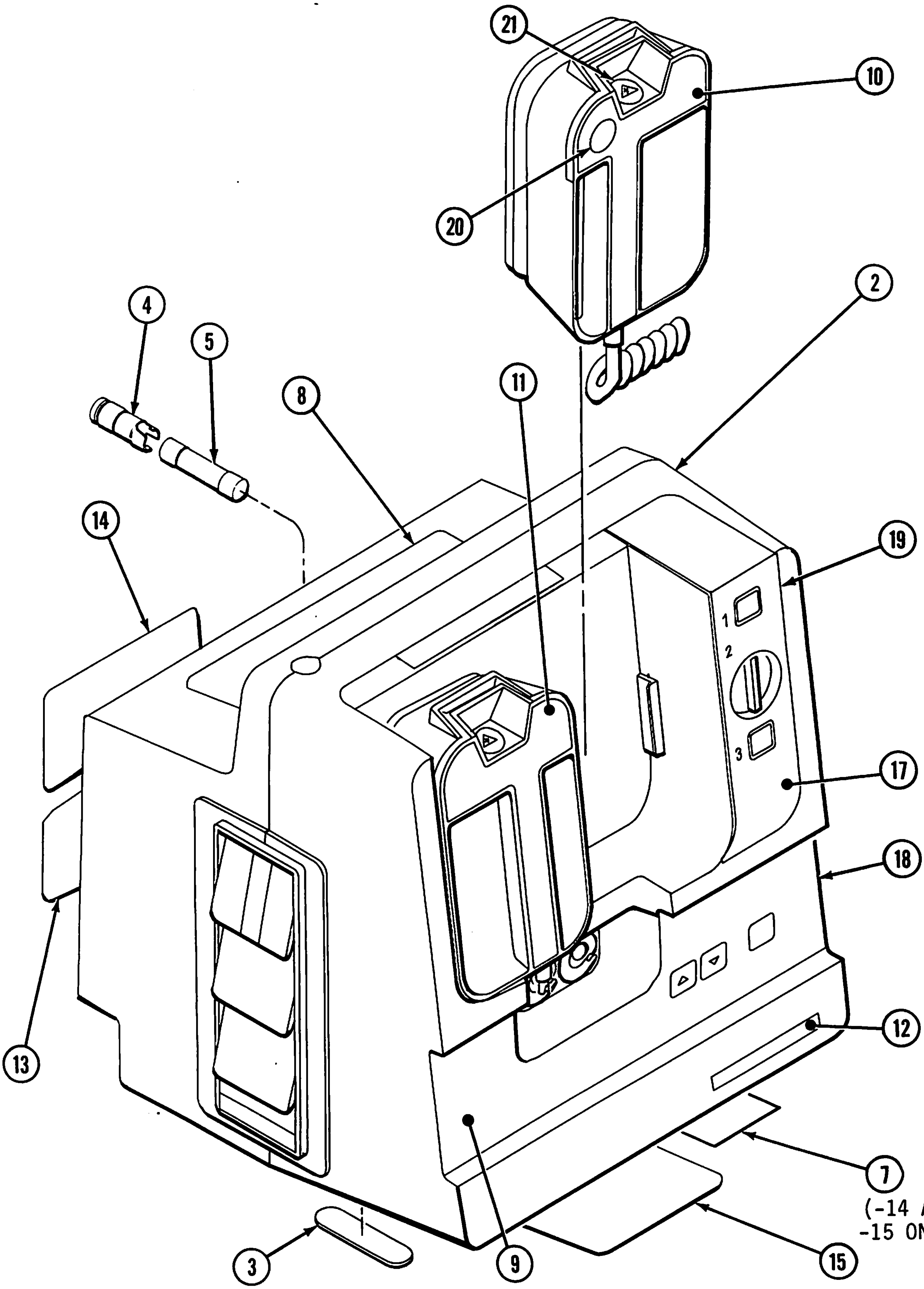
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(-14 AND
-15 ONLY)
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3

FIGURE 5-21. DEFIBRILLATOR FINAL ASSEMBLY

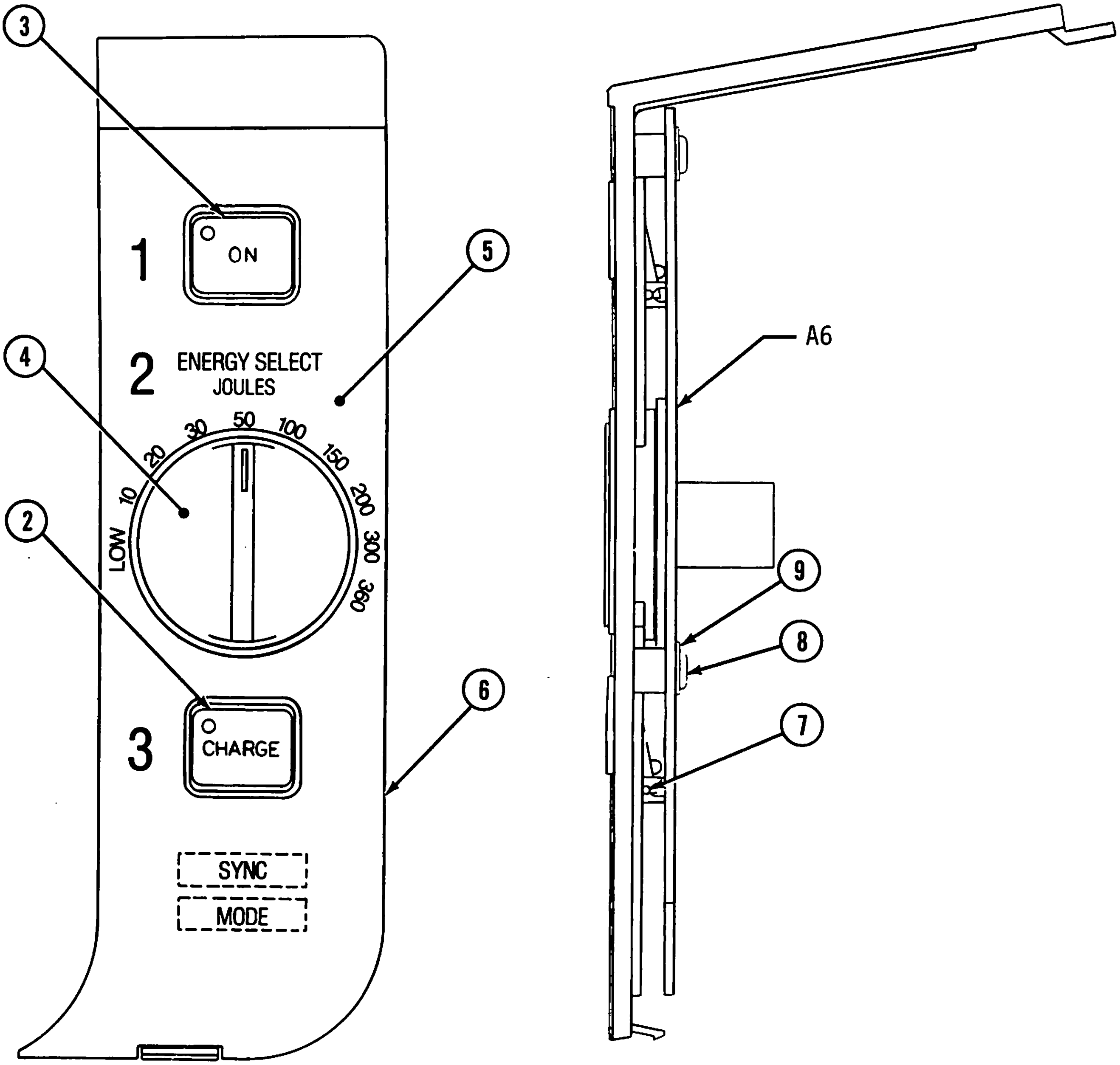
802700

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-21				
	802700-07	DEFIBRILLATOR FINAL ASSEMBLY, 100/120V, English, CLA	A	REF
	802700-08	DEFIBRILLATOR FINAL ASSEMBLY, 220/240V, English (U/K)	B	REF
	802700-09	DEFIBRILLATOR FINAL ASSEMBLY, 100/120V, French	C	REF
	802700-10	DEFIBRILLATOR FINAL ASSEMBLY, 220/240V, French	D	REF
	802700-11	DEFIBRILLATOR FINAL ASSEMBLY, 220/240V, German	E	REF
	802700-12	DEFIBRILLATOR FINAL ASSEMBLY, 100/120V, Spanish	F	REF
	802700-13	DEFIBRILLATOR FINAL ASSEMBLY, 220/240V, Spanish	G	REF
	802700-14	DEFIBRILLATOR FINAL ASSEMBLY, 120V, English, CSA	H	REF
	802700-15	DEFIBRILLATOR FINAL ASSEMBLY, 120V, French, CSA	I	REF
	802700-16	DEFIBRILLATOR FINAL ASSEMBLY, 120V, English, UL	J	REF
2	802701-03	. GENERIC DEFIBRILLATOR ASSEMBLY		1
3	802885-00	. FOOT, Mounting		4
4	201203-014	. FUSE CARRIER, 3AC	A,C,F,H, I,J	2
	201203-15	. FUSE CARRIER, 5 X 20mm	B,D,E,G	2
5	200256-149	. FUSE, Slow Blow, 3A/250V	A,C,F,H, I,J	2
	200619-020	. FUSE, Slow Blow, 5 X 20mm, 3.15A/250V	B,D,E,G	2
6	200795-000	. LABEL, Approval, CLA (Not Shown)	A,J	1
7	803982-00	. LABEL, CSA Disclaimer, English/French	H,I	1
8	802772-00	. LABEL, Instruction, English	A,B,J	1
	802772-01	. LABEL, Instruction, French	C,D	1
	802772-02	. LABEL, Instruction, German	E	1
	802772-03	. LABEL, Instruction, Spanish	F,G	1
	802772-04	. LABEL, Instruction, English, CSA	H	1
	802772-05	. LABEL, Instruction, French, CSA	I	1
9	802773-00	. LABEL, Lower Front, English	A,B,H,J	1
	802773-01	. LABEL, Lower Front, French	C,D,I	1
	802773-02	. LABEL, Lower Front, German	E	1
	802773-03	. LABEL, Lower Front, Spanish	F,G	1
10	802940-00	. LABEL, Paddle, Apex		1
11	802940-01	. LABEL, Paddle, Sternum, English/French/German	A-E,H,I,J	1
	802940-02	. LABEL, Paddle, Sternum, Spanish	F,G	1
12	802768-01	. LABEL, Product Name, English/German	A,B,E,H,J	1
	802768-03	. LABEL, Product Name, French	C,D,I	1
	802768-05	. LABEL, Product Name, Spanish	F,G	1
13	802774-00	. LABEL, Rear Caution, English	A,B,H,J	1
	802774-01	. LABEL, Rear Caution, French	C,D,I	1
	802774-02	. LABEL, Rear Caution, German	E	1
	802774-03	. LABEL, Rear Caution, Spanish	F,G	1
14	802767-01	. LABEL, Rear Control, French	C,I	1
	802767-03	. LABEL, Rear Control, Spanish	F	1
	802767-05	. LABEL, Rear Control, English	A,H,J	1
	802767-07	. LABEL, Rear Control, French	D	1
	802767-08	. LABEL, Rear Control, Spanish	G	1
	802767-09	. LABEL, Rear Control, U/K	B	1
	802767-10	. LABEL, Rear Control, German	E	1
15	802864-01	. LABEL, Serial Number, French	C,D	1
	802864-02	. LABEL, Serial Number, German	E	1
	802864-03	. LABEL, Serial Number, Spanish	F,G	1
	802864-04	. LABEL, Serial Number, English	A,J	1
	802864-05	. LABEL, Serial Number, English, CSA	H	1
	802864-06	. LABEL, Serial Number, French, CSA	I	1
	802864-07	. LABEL, Serial Number, English, 220/240V	B	1
16	801517-04	. LABEL, U.L. (Not Shown)	J	1
17	802775-00	. LABEL, Upper Front, English	A,B,H,J	1
	802775-01	. LABEL, Upper Front, French	C,D,I	1
	802775-02	. LABEL, Upper Front, German	E	1
	802775-03	. LABEL, Upper Front, Spanish	F,G	1
18	802702-05	. LOWER FRONT PANEL ASSEMBLY, English	A,B,H	1
	802702-06	. LOWER FRONT PANEL ASSEMBLY, French	C,D,I	1
	802702-07	. LOWER FRONT PANEL ASSEMBLY, German	E	1
	802702-08	. LOWER FRONT PANEL ASSEMBLY, Spanish	F,G	1
19	802707-05	. UPPER FRONT PANEL ASSEMBLY, English	A,B,H	1
	802707-06	. UPPER FRONT PANEL ASSEMBLY, French	C,D,I	1
	802707-07	. UPPER FRONT PANEL ASSEMBLY, German	E	1
	802707-08	. UPPER FRONT PANEL ASSEMBLY, Spanish	F,G	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-21				
20	802935-05	. PUSH BUTTON, Paddle, Charge, English/French	A-D,H,I,J	1
	802935-06	. PUSH BUTTON, Paddle, Charge, German	E	1
	802935-07	. PUSH BUTTON, Paddle, Charge, Spanish	F,G	1
21	802935-08	. PUSH BUTTON, Paddle, Discharge, 100/120V	A,C,F,H, I,J	2
	802935-09	. PUSH BUTTON, Paddle, Discharge, 220/240V	B,D,E,G	2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ON
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A6
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ENERGY SELECT
JOULES
LOW
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100
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200
300
360
2
9
8
6
3
CHARGE
7
SYNC
MODE

802707

FIGURE 5-22. UPPER FRONT PANEL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-22				
	802707-05	UPPER FRONT PANEL ASSEMBLY, English	A	REF
	802707-06	UPPER FRONT PANEL ASSEMBLY, French	B	REF
	802707-07	UPPER FRONT PANEL ASSEMBLY, German	C	REF
	802707-08	UPPER FRONT PANEL ASSEMBLY, Spanish	D	REF
A6	802711-01	. UPPER SWITCH MODULE PCB ASSEMBLY (See Figure 5-33)		1
2	802883-06	. KEY, Single, With Lens, CHARGE, English/French	A,B	1
	802883-21	. KEY, Single, With Lens, CHARGE, Spanish	D	1
	802883-26	. KEY, Single, With Lens, CHARGE, German	C	1
3	802883-00	. KEY, Single, With Lens, ON, English	A	1
	802883-11	. KEY, Single, With Lens, ON, International	B-D	1
4	802748-00	. KNOB, Energy Select		1
5	802775-00	. LABEL, Upper Front, English	A	1
	802775-01	. LABEL, Upper Front, French	B	1
	802775-02	. LABEL, Upper Front, German	C	1
	802775-03	. LABEL, Upper Front, Spanish	D	1
6	802738-00	. PANEL, Upper Front, With Inserts		1
7	802776-00	. PIN, Hinge, 1.105 L		2
8	200476-762	. SCREW, Pan Head, 4-40 X .375 L		3
9	90-04008	. WASHER, Flat, #4 X .312 OD		3

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-24				
	802701-00	GENERIC DEFIBRILLATOR ASSEMBLY	A	REF
	802701-01	GENERIC DEFIBRILLATOR ASSEMBLY	B	REF
	802701-02	GENERIC DEFIBRILLATOR ASSEMBLY	C	REF
	802701-03	GENERIC DEFIBRILLATOR ASSEMBLY	D	REF
A1	802715-02	. MAIN PCB ASSEMBLY (See Figure 5-29) ATTENTION	A,B	1
	802715-03	. MAIN PCB ASSEMBLY	C,D	
A2	802719-02	. POWER SUPPLY PCB ASSEMBLY (See Figure 5-28)	A	1
	802719-04	. POWER SUPPLY PCB ASSEMBLY	B	
	802719-06	. POWER SUPPLY PCB ASSEMBLY	C,D	1
A3	800240-05	. TRANSFER RELAY ASSEMBLY		1
A4	802901-04	. GENERIC APEX PADDLE ASSEMBLY (See Figure 5-25)		1
A5	802901-05	. GENERIC STERNUM PADDLE ASSEMBLY (See Figure 5-25)		1
A8	802725-03	. LOGIC PCB ASSEMBLY (See Figure 5-30) ATTENTION	A	1
	802725-04	. LOGIC PCB ASSEMBLY	A	1
	802725-05	. LOGIC PCB ASSEMBLY	A	1
	802725-06	. LOGIC PCB ASSEMBLY	A	1
	802725-07	. LOGIC PCB ASSEMBLY	B	1
	802725-08	. LOGIC PCB ASSEMBLY	C,D	1
A9	803569-01	. CASSETTE INTERFACE PCB ASSEMBLY (See Figure 5-35)		1
A10	802713-02	. TEST LOAD PCB ASSEMBLY (See Figure 5-32)		1
A11	802717-01	. OPTICAL INTERFACE PCB ASSEMBLY (See Figure 5-31)		1
A15	802703-01	. REAR PANEL ASSEMBLY (See Figure 5-26)	A,B	1
	802703-02	. REAR PANEL ASSEMBLY	C	1
	802703-03	. REAR PANEL ASSEMBLY	D	1
W1	802797-00	. CASSETTE PFC ASSEMBLY		
	802723-01	. CASSETTE PFC ASSEMBLY (Used With 802725-04 Only)		1
W2	802786-00	. LOGIC/OPTICAL INTERFACE RIBBON CABLE ASSEMBLY		1
W3	802721-03	. CONTROL PFC ASSEMBLY (See Figure 5-36)		1
W4	802779-00	. PADDLE/MAIN PCB LEAD ASSEMBLY (Not Shown)		1
W5	802798-00	. TRANSFER RELAY/MAIN PCB LEAD ASSEMBLY (Not Shown)		1
W6	802789-00	. BATTERY WIRING HARNESS		1
2	802791-00	. BATTERY PAK, Matched Pair		1
3	200405-020	. CABLE, Unshielded, 1 Conductor, 22 AWG, Stranded, 20kV		A/R
4	802784-01	. CAPACITOR, Energy Storage, 32 µF, 360J		1
5	802734-00	. CASE, Front	A,B	1
	802734-01	. CASE, Front	C,D	1
6	802747-00	. CASE, Rear	A,B	1
	802747-01	. CASE, Rear	C,D	1
7	201845-000	. CLIP, Nylon, Flat Ribbon Cable, With Adhesive		1
8	802736-01	. CONDUIT, With Inserts		1
9	802735-00	. CONNECTOR, Module B, With Inserts		1
10	802783-01	. CONTACT, Paddle, With Rivets		2
11	802780-03	. CONTACT, Test Load, With Rivet		2
12	802744-00	. COVER, Cassette Receptacle	A,B	1
	802744-02	. COVER, Cassette Receptacle	C,D	1
13	802733-01	. COVER, Conduit		1
14	802754-00	. COVER, LED	A,B	1
	802754-01	. COVER, LED	C,D	1
15	802885-00	. FOOT, Mounting		4
16	201813-001	. HEADER, Double, Locking, 3 Contact		1
17	201813-003	. HEADER, Double, Locking, 5 Contact		1
18	802793-03	. INDUCTOR, Wave Shaping		1
19	803567-00	. INDUCTOR ASSEMBLY, EMI Suppression, Apex Paddle		1
20	803567-01	. INDUCTOR ASSEMBLY, EMI Suppression, Sternum Paddle		1
21	802751-00	. INSERT, Handle		1
22	802743-00	. INSERT, Cassette Receptacle		1
23	802762-01	. INSULATOR, Capacitor		1
24	803456-09	. LABEL, Battery Specification		2
25	800943-09	. LABEL, Symbol, International, High Voltage	A-C	5
	800943-09	. LABEL, Symbol, International, High Voltage	D	4
26	802756-00	. LATCH, Connector	A,B	1
	803572-00	. LATCH, Connector	C,D	1
27	90-03021	. NUT, Hex, Kep, 6-32 X .250 W/.098 T		4

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-24				
28	802776-02	. PIN, Hinge	A,B	1
	803570-00	. PIN, Hinge, Latch Connector	C,D	1
29	802770-00	. PLATE, Retainer, Latch Connector		1
30	802765-00	. PUSHBUTTON, Latch Connector	A,B	1
	802765-01	. PUSHBUTTON, Latch Connector	C	1
	802765-02	. PUSHBUTTON, Latch Connector	D	1
31	802737-00	. RECEPTACLE, Paddle, With Inserts		1
32	800516-01	. RESISTOR ASSEMBLY		1
33	200536-009	. RETAINER, Cable Tie, Nylon, .10 W X 4.06 L (Not Shown)		A/R
34	90-10042	. RETAINER, Cable Tie, Nylon, .35 W X 21.0 L		2
35	200364-048	. RETAINER, PCB, Locking, .375 L		3
36	200364-050	. RETAINER, PCB, Locking, .750 L		6
37	802926-02	. RETAINER, Pacing Cassette PFC		2
38	802750-00	. ROLLER, Coil Cord		2
39	200531-014	. SCREW, Pan Head, Dual Threaded, 6-19 X .375 L		8
40	200476-759	. SCREW, Pan Head, 4-40 X .187 L		5
41	200476-760	. SCREW, Pan Head, 4-40 X .250 L		2
42	200476-761	. SCREW, Pan Head, 4-40 X .312 L		4
43	200476-793	. SCREW, Pan Head, 6-32 X .312 L		21
44	200476-794	. SCREW, Pan Head, 6-32 X .375 L		4
45	200476-800	. SCREW, Pan Head, 6-32 X .75 L		4
46	200531-016	. SCREW, Pan Head, Dual Threaded, 6-19 X .500 L		4
47	802766-00	. SHAFT, Connector Latch		1
48	802763-01	. SHIELD, Test Load		1
49	804158-00	. SHIELD, Moisture, Button (Used on Item 30, Not Shown)		1
50	804140-00	. SHIELD, Moisture, Rear Panel		1
51	201625-019	. SPRING, Coil, .360 OD X .75 L X .026 T		1
52	200159-003	. SPRING, Compression, .300 OD X .81 L X .042 T		1
53	802778-00	. SPRING, Cassette Cover		2
54	200267-020	. TERMINAL, Receptacle, Quick Disconnect, Insulated, 22-18 AWG		1
55	200514-006	. TERMINAL, Receptacle, Quick Disconnect, 90°, 22-18 AWG		2
56	200514-000	. TERMINAL, Receptacle, Quick Disconnect, 90°, 22-18 AWG		1
57	802927-00	. TUBE, Elastomeric		2
58	802764-00	. WASHER, Flat, Aluminum		2
59	200144-074	. WASHER, Flat, Insulated, Nylon, .141 ID, .562 OD, .062 T		2
60	201575-002	. WASHER, Lock, Internal Tooth, #4 X .260 OD/.015 T		9
61	90-04014	. WASHER, Lock, Internal Tooth, #6 X .285 OD/.025 T		4

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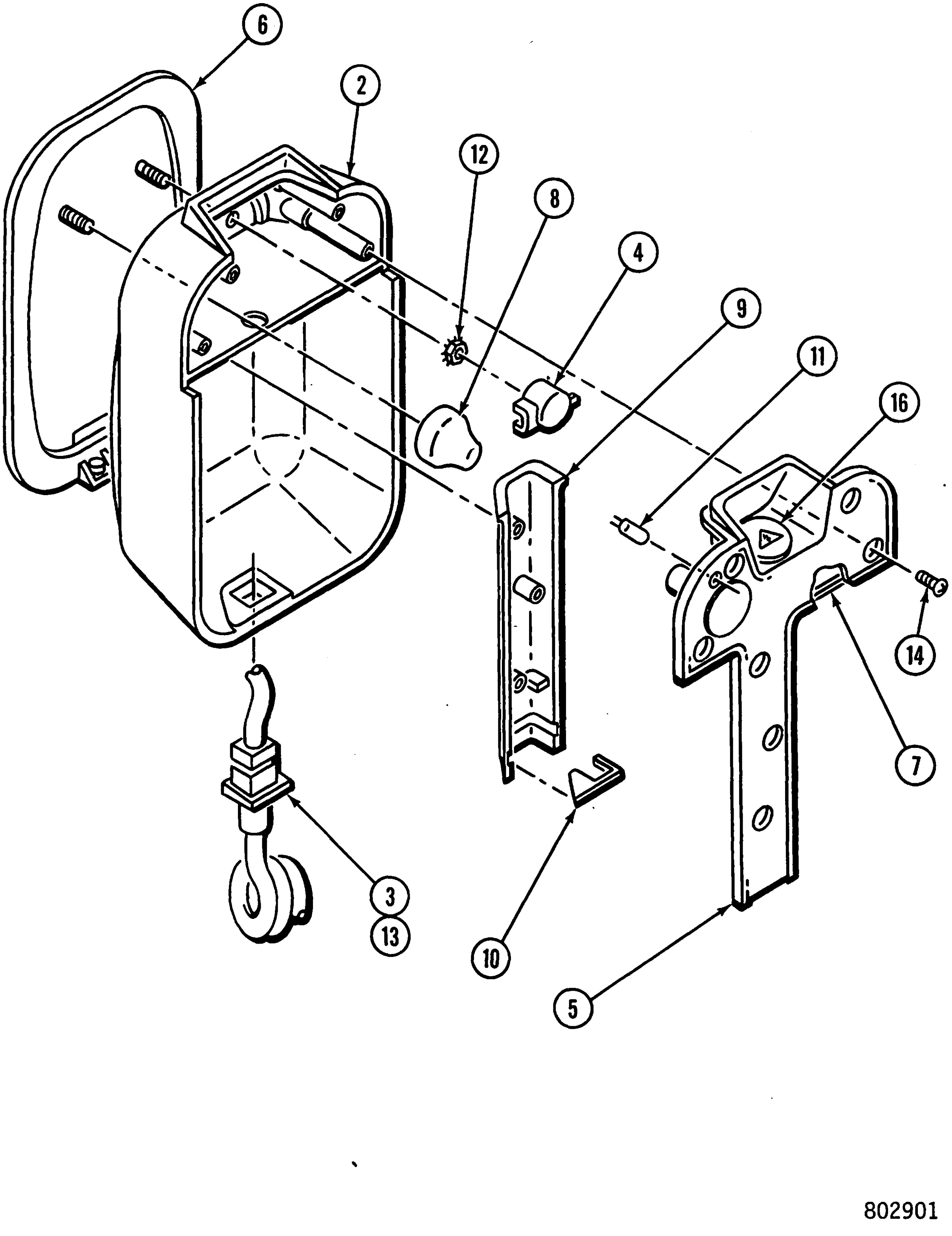
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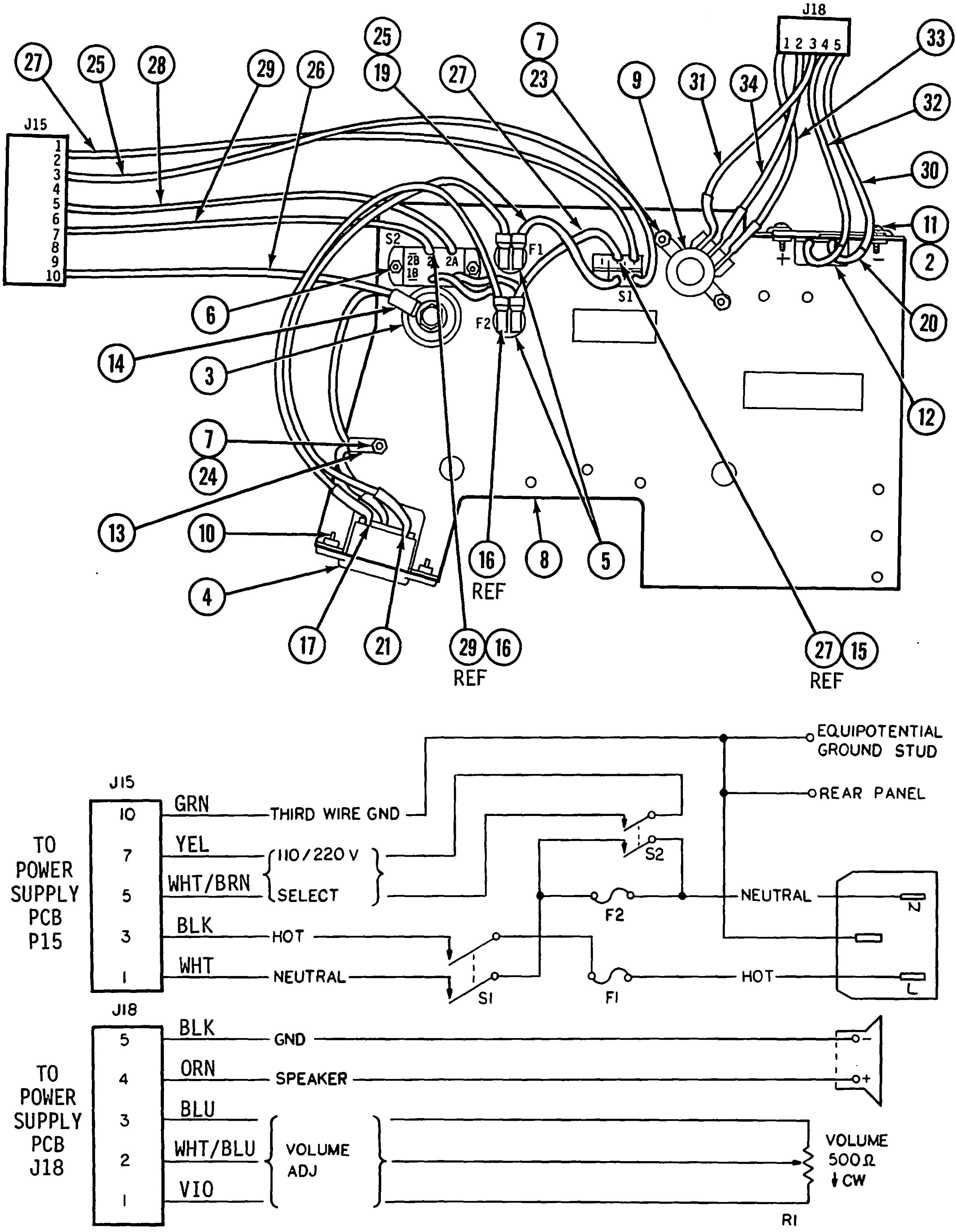
FIGURE 5-25. GENERIC APEX AND STERNUM PADDLE ASSEMBLIES

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-25				
A4	802901-04	GENERIC PADDLE ASSEMBLY, Apex	A	REF
A5	802901-05	GENERIC PADDLE ASSEMBLY, Sternum	B	REF
2	802930-04	. BASE, Apex Paddle	A	1
	802930-03	. BASE, Sternum Paddle	B	1
3	802920-06	. COIL CORD ASSEMBLY, Apex	A	1
	802920-05	. COIL CORD ASSEMBLY, Sternum	B	1
4	802936-00	. COVER, High Voltage Terminal		1
5	802934-02	. COVER, Apex Paddle	A	1
	802934-03	. COVER, Sternum Paddle	B	1
6	802902-02	. ELECTRODE PLATE ASSEMBLY, Apex Paddle	A	1
	802902-03	. ELECTRODE PLATE ASSEMBLY, Sternum Paddle	B	1
7	802944-00	. GASKET, Paddle		1
8	800256-04	. GUARD, Electrode Plate Terminal		1
9	802931-00	. HANDLE, Paddle	A	1
	802931-01	. HANDLE, Paddle	B	1
10	802932-00	. KEY, Retainer, Coil Cord		1
11	200491-048	. LED, Panel Mount	A	1
12	90-03022	. NUT, Hex, Kep, 8-32 X .312 W/.100 T		3
13	200536-009	. RETAINER, Cable Tie, Nylon, 4.06 L	A	2
	200536-009	. RETAINER, Cable Tie, Nylon, 4.06 L	B	1
14	201103-537	. SCREW, Pan Head, Black Oxide, 4-40 X .312 L		7
15	90-09035	. SEALANT, RTV, White (Not Shown)		A/R
16	801226-02	. SWITCH, Push Button, SPST, 1/4 A	A	2
	801226-02	. SWITCH, Push Button, SPST, 1/4 A	B	1


J15
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J18
1 2 3 4 5
33
32
30
11
2
20
12
S2
2B
1B
2
2A
F1
F2
S1
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24
13
10
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17
21
29
16
REF
16
REF
8
5
27
15
REF
J15
TO POWER SUPPLY PCB P15
10
7
5
3
1
GRN
YEL
WHT/BRN
BLK
WHT
THIRD WIRE GND
110/220 V SELECT
HOT
NEUTRAL
S2
S1
F2
F1
EQUIPOTENTIAL GROUND STUD
REAR PANEL
NEUTRAL
HOT
N
L
J18
TO POWER SUPPLY PCB J18
5
4
3
2
1
BLK
ORN
BLU
WHT/BLU
VIO
GND
SPEAKER
VOLUME ADJ
−
+
VOLUME 500Ω
CW
R1

802703

FIGURE 5-26. REAR PANEL ASSEMBLY

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-26	802703-01	REAR PANEL ASSEMBLY	A	REF
	802703-02	REAR PANEL ASSEMBLY	B	REF
	802703-03	REAR PANEL ASSEMBLY	C	REF
J15	200277-008	. CONNECTOR, Housing, Receptacle, 10 Contact		1
J18	201811-138	. CONNECTOR, 22 AWG, 5 Contact		1
S1	201665-006	. SWITCH, Rocker, DPST, On/None/Off		1
S2	201150-001	. SWITCH, Slide, Maintained, Panel Mount		1
2	201439-001	. CLAMP, Component		2
3	201393-011	. CONNECTOR, Plug, Equipotential		1
4	201296-021	. CONNECTOR, Plug, AC Power, 3 Contact		1
5	201203-002	. FUSEHOLDER	A	2
	201203-016	. FUSE HOLDER, Body Only	B,C	2
6	90-03019	. NUT, Hex, Kep, 4-40 X .25 W		2
7	90-03021	. NUT, Hex, Kep, 6-32 X .25 W		3
8	802771-00	. PANEL, Rear	A,B	1
	802771-01	. PANEL, Rear	C	1
9	802788-00	. POTENTIOMETER, Alarm Volume		1
10	901195	. SCREW, Flat Head, 4-40 X .312 L		2
11	200476-761	. SCREW, Pan Head, 4-40 X .312 L		2
12	201148-012	. SPEAKER, 8 Ω		1
13	200276-207	. TERMINAL, Lug, Ring, #6 Stud, 16-14 AWG		1
14	200276-114	. TERMINAL, Lug, Ring, 1/4" Stud, 16-14 AWG		1
15	200916-003	. TERMINAL, Receptacle, Quick Disconnect, .187 X .032, 22-18 AWG		4
16	200267-040	. TERMINAL, Receptacle, Disconnect, Insulated, .110 X .032, 22-18 AWG		4
17	200514-008	. TERMINAL, Receptacle, Insulated, 14-16 AWG, .187 X .020		2
18	200390-016	. TERMINAL, Socket, Crimp, 18-24 AWG (For J15)		5
19	200514-006	. TERMINAL, Quick Disconnect, Insulated, 22-18 AWG, .187 X .020		2
20	200283-017	. TUBING, Heat Shrink, Black, .125 I.D.		A/R
21	200283-018	. TUBING, Heat Shrink, Black, .187 I.D.		A/R
22	90-07022	. TUBING, PVC, Clear, #8 (Not Shown)		A/R
23	90-04010	. WASHER, Flat, #6, .375 OD, .050 T		2
24	90-04014	. WASHER, Lock, Internal, #6, .285 OD, .025 T		1
25	200357-055	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Black		A/R
26	200357-057	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Green	A	A/R
	200357-272	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Green/Yellow	B,C	A/R
27	200357-054	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, White		A/R
28	200357-069	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, White/Brown		A/R
29	200357-058	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Yellow		A/R
30	201535-018	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Black		A/R
31	201535-024	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Blue		A/R
32	201535-021	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Orange		A/R
33	201535-025	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Violet		A/R
34	201535-031	. WIRE, Stranded, PVC, 300V, 18 AWG, CSA, Green/Yellow	B,C	A/R

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PARTS LIST

FIG-ITEM	PART NUMBER	1 2 3 4 5 6 7 DESCRIPTION	USE CODE	QTY
5-28				
A2	802719-02	POWER SUPPLY PCB ASSEMBLY	A	REF
	802719-04	POWER SUPPLY PCB ASSEMBLY	B	REF
	802719-06	POWER SUPPLY PCB ASSEMBLY	C	REF
C3	200205-056	. CAPACITOR, Electrolytic, 470µF/50V, 50%	A,B	1
	200205-079	. CAPACITOR, Electrolytic, 220µF/100V, 50%	C	1
C4,5	201554-056	. CAPACITOR, Electrolytic, 470µF/200V, 30%		2
C6	200680-013	. CAPACITOR, 1µF/400V, 10%		1
C8	201628-072	. CAPACITOR, .1µF/50V, 10%	A,B	2
	201628-072	. CAPACITOR, .1µF/50V, 10%	C	4
C9	200701-026	. CAPACITOR, Electrolytic, 100µF/35V, 20%		1
C10		. (Same As C19)	A,B	
		. (Same As C8)	C	
C11	200701-036	. CAPACITOR, Electrolytic, 220µF/50V, 100%		1
C12	200214-020	. CAPACITOR, .047µF/50V, 5%	A,B	1
	201628-010	. CAPACITOR, .047µF/50V, 5%	C	1
C13	200901-022	. CAPACITOR, 100pF/50V, 5%		1
C14		. (Same As C8)		
C15	200901-039	. CAPACITOR, 2700pF/50V, 5%		1
C16	201628-018	. CAPACITOR, 1µF/50V, 5%		1
C17	200901-095	. CAPACITOR, 1000pF/100V, 5%		1
C18	200593-001	. CAPACITOR, 100pF/1kV, 10%		1
C19	200701-017	. CAPACITOR, Electrolytic, 100µF/25V, 20%	A,B	2
	200701-017	. CAPACITOR, Electrolytic, 100µF/25V, 20%	C	1
C20	200456-103	. CAPACITOR, Electrolytic, 100µF/25V, +75%		1
C21		. (Same As C8)	C	
C22	200205-019	. CAPACITOR, Electrolytic, 220µF/16V, +50%	C	1
C27	200205-024	. CAPACITOR, Electrolytic, 10µF/25V, 50%		1
C28	201216-013	. CAPACITOR, .1µF/250V, ±20%	C	1
CR1	02-14173-00	. DIODE, Bridge, VM48, 400V, 1A	A,B	1
	202017-000	. DIODE, Bridge, VM48, 400V, 1A	C	1
CR3	200499-028	. DIODE, Bridge, FWLC1000, PIV 1000, 4A		1
CR4,5	200605-018	. DIODE, Zener, 1N4746A, 18V, 250mA		4
CR6,7,	200658-002	. DIODE, MR812, 200nS, PIV 200		4
CR8,9		. (Same As CR4)		
CR10		. (Same As CR6)		
CR11	200284-001	. DIODE, 1N4001, PIV 50, 1A	A,B	2
	200284-001	. DIODE, 1N4001, PIV 50, 1A	C	1
CR12,13	201128-000	. DIODE, 3XF1, 250nS, PIV 100		2
CR14		. (Same As CR11)	A,B	
	200177-041	. DIODE, Zener, P6KE47A	C	1
CR15	201553-004	. DIODE, 2602, PIV 100, 50A		1
CR16		. (Same As CR6)		
CR26	200605-004	. DIODE, Zener, 1N4732A, 970mA/4.7V		1
CR27	200086-021	. DIODE, Zener, 1N4106, 20.4mA/12V		1
CR28	200971-000	. DIODE, 1N914B, 8nS, PIV 75	A,B	1
	200971-000	. DIODE, 1N914B, 8nS, PIV 75	C	2
CR29	200605-012	. DIODE, Zener, 1N4740A, 25mA/10V	A,B	1
	200086-018	. DIODE, Zener, 1N4103, 26.2mA/9.1V	C	1
CR30	200083-004	. DIODE, 1N5821, 3A, PIV 30	C	1
CR31		. (Same As CR28)	C	
F1	200603-010	. FUSE, Fast Blow, .8A/250V		1
F2	200603-018	. FUSE, Fast Blow, 5A/250V		1
F3	200619-035	. FUSE, Slow Blow, .25A/250V	A,B	1
F4	201167-018	. FUSE, Fast Blow, 15A/32V		1
F5	200256-118	. FUSE, Slow Blow, 2.50A/125V		1
F6	201167-009	. FUSE, Fast Blow, 2.5A/125V		1
F7,8	201167-004	. FUSE, Fast Blow, .50A/125V	A,B	2
F9,10	201167-015	. FUSE, Fast Blow, 10A/125V		2
J19	201701-017	. CONNECTOR, Receptacle, 9 Contact		1
K1	201537-000	. RELAY, 12Vdc, 10A, SPDT		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-28				
L1	802525-00	. INDUCTOR, RFI Suppression	A,B	1
	802525-01	. INDUCTOR, RFI Suppression	C	1
L2	802614-00	. INDUCTOR, Toroid		1
L3,4	200808-001	. INDUCTOR, Ferrite Bead		2
P8	200396-003	. CONNECTOR, Header, 5 Contact		1
P11	201678-031	. CONNECTOR, Plug, 32 Contact		1
P15	200096-008	. CONNECTOR, Plug, Locking, 10 Contact		1
P17A	201504-003	. TERMINAL, Quick Connect, .187 W/.020 T		1
P17B	201504-004	. TERMINAL, Quick Connect, .250 W/.032 T		1
P18	200534-003	. CONNECTOR, Plug, 5 Contact		1
Q1,2	201569-000	. TRANSISTOR, FET, IRF830, TO-220		2
Q3-5	200888-001	. TRANSISTOR, PNP, PN2907A, TO-92		4
Q6	200387-001	. TRANSISTOR, NPN, MPSA14, TO-92	A,B	1
		. (Same As Q7)	C	
Q7	200942-001	. TRANSISTOR, NPN, PN2222A, TO-92		4
Q8		. (Same As Q3)		
Q9		. (Same As Q7)		
Q10	201350-001	. TRANSISTOR, PNP, TIP32A, TO-220	A,B	1
	201350-003	. TRANSISTOR, PNP, TIP32C, TO-220	C	1
Q11		. (Same as Q7)	A,B	
	201175-000	. TRANSISTOR, NPN, PN5832, TO-92	C	1
Q12	200585-001	. TRANSISTOR, FET, VN0106N3, TO-92	A,B	1
		. (Same As Q7)	C	
Q13		. (Same As Q7)	A,B	
	200585-001	. TRANSISTOR, FET, VN0106N3, TO-92	C	1
R2,3	200471-124	. RESISTOR, 150 kΩ, 1/2W, 5%		2
R4,5	200054-222	. RESISTOR, 2 kΩ, 1/8W, 1%, RN55C		2
R6,7	200054-085	. RESISTOR, 75 Ω, 1/8W, 1%, RN55C		2
R9	200120-071	. RESISTOR, 2.4 kΩ, 1W, 5%		1
R10	200471-026	. RESISTOR, 12 Ω, 1/2W, 5%		1
R11	200471-024	. RESISTOR, 10 Ω, 1/2W, 5%		1
R12	200471-036	. RESISTOR, 33 Ω, 1/2W, 5%		1
R13	200676-039	. RESISTOR, 390 Ω, 3W, 5%		1
R15	200471-059	. RESISTOR, 300 Ω, 1/2W, 5%		1
R24	200054-121	. RESISTOR, 178 Ω, 1/8W, 1%, RN55C		1
R26	200054-030	. RESISTOR, 20 Ω, 1/8W, 1%, RN55C		1
R27,28	200270-081	. RESISTOR, 240 Ω, 2W, 5%		2
R52		. (Same As R56)	A,B	
	200054-134	. RESISTOR, 243 Ω, 1/8W, 1%, RN55C	C	1
R53	200054-226	. RESISTOR, 2.21 kΩ, 1/8W, 1%, RN55C		1
R56	200054-069	. RESISTOR, 49.9 Ω, 1/8W, 1%, RN55C	A,B	2
	200054-069	. RESISTOR, 49.9 Ω, 1/8W, 1%, RN55C	C	1
R57	200470-097	. RESISTOR, 11 kΩ, 1/4W, 5%	A,B	1
	200471-104	. RESISTOR, 22 kΩ, 1/2W, 5%	C	2
R58	200470-072	. RESISTOR, 1 kΩ, 1/4W, 5%	A,B	2
	200054-413	. RESISTOR, 200 kΩ, 1/8W, 1%, RN55C	C	1
R59		. (Same As R58)	A,B	
	200054-442	. RESISTOR, 402 kΩ, 1/8W, 1%, RN55C	C	1
R61		. (Same As R57)	C	
R62	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C	C	1
R63,64	200470-017	. RESISTOR, 5.1 Ω, 1/4W, 5%	C	2
RN1	802792-01	. RESISTOR NETWORK, Multi-Value, 16 Pin		1
RT1	200486-004	. THERMISTOR, Surge Arresting, 4 Amp Maximum		1
RV1	201251-167	. VARISTOR, 275V, 4000A, 40J		1
RV2-6	201251-000	. VARISTOR, 18V, 250A, 0.5J		5
TP1-7	801959-00	. TERMINAL, Test Point		7
T1	802796-00	. TRANSFORMER, 60Hz	A	1
	802796-01	. TRANSFORMER, 60Hz	B	1
	802796-02	. TRANSFORMER, 60Hz	C	1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-28				
T2	802522-01	. TRANSFORMER, Linear Power, 50kHz	A	1
	802522-02	. TRANSFORMER, Linear Power, 50kHz	B	1
	802522-03	. TRANSFORMER, Linear Power, 50kHz	C	1
T3	802524-00	. TRANSFORMER, Base Drive, 50kHz	A	1
	802524-01	. TRANSFORMER, Base Drive, 50kHz	B,C	1
U1	201126-000	. I.C., Linear, SG3525A, Pulse Width Modulator		1
U2	201597-000	. I.C., Linear, CNY65, Opto-Isolator		1
U3	200414-000	. I.C., Linear, LM317T, Voltage Regulator, TO-220		1
VSP1,2	200324-001	. VOLTAGE SURGE PROTECTOR, 90V, 1pF		2
2	90-09328	. ADHESIVE, Hot Melt		A/R
3	802777-00	. HEAT SINK, Diode, TO-3		1
4	200993-004	. HEAT SINK, Transistor, TO-220	A,B	1
	202091-037	. HEAT SINK, Transistor, TO-220	C	1
5	90-09106	. INSULATOR, Silipad, TO-3		1
6	90-09227	. INSULATOR, Silipad, TO-220		2
7	90-03019	. NUT, Hex, Kep, 4-40 X .250 W/.098 T		2
8	90-03021	. NUT, Hex, Kep, 6-32 X .250 W/.098 T		2
9	90-03043	. NUT, Hex, Nylon, 4-40 X .250 W/.150 T		3
10	201156-000	. RETAINER, Fuseholder (Used With F1-3)	A,B	6
	201156-000	. RETAINER, Fuseholder (Used With F1,2)	C	4
11	201345-001	. RETAINER, Fuseholder (Used With F5)		2
12	201773-000	. RIVET, Semi-Tubular, Aluminum, .087 D X .343 L		2
13	200476-761	. SCREW, Pan Head, 4-40 X .312 L		2
14	200476-794	. SCREW, Pan Head, 6-32 X .375 L		2
15	201112-037	. SCREW, Pan Head, Nylon, 4-40 X .312 L		2
16	201112-038	. SCREW, Pan Head, Nylon, 4-40 X .375 L		1
17	90-07024	. TUBING, PVC, Clear, #16	A,B	A/R
18	200624-015	. TUBING, Teflon, Natural, #7 (Not Shown, Used With F4, F6-10)		A/R
19	200431-553	. WASHER, Shoulder, Nylon, Natural, #6		2
20	201301-267	. WIRE, Jumper, Insulated, Copper, 1.40 L (Used on WP2A-B)	C	1
21	201301-279	. WIRE, Jumper, Insulated, Copper, 2.00 L (Used on WP3A-B)	C	1
22	200357-109	. WIRE, Stranded, PVC, 300V, 22 AWG, CSA, Black		A/R

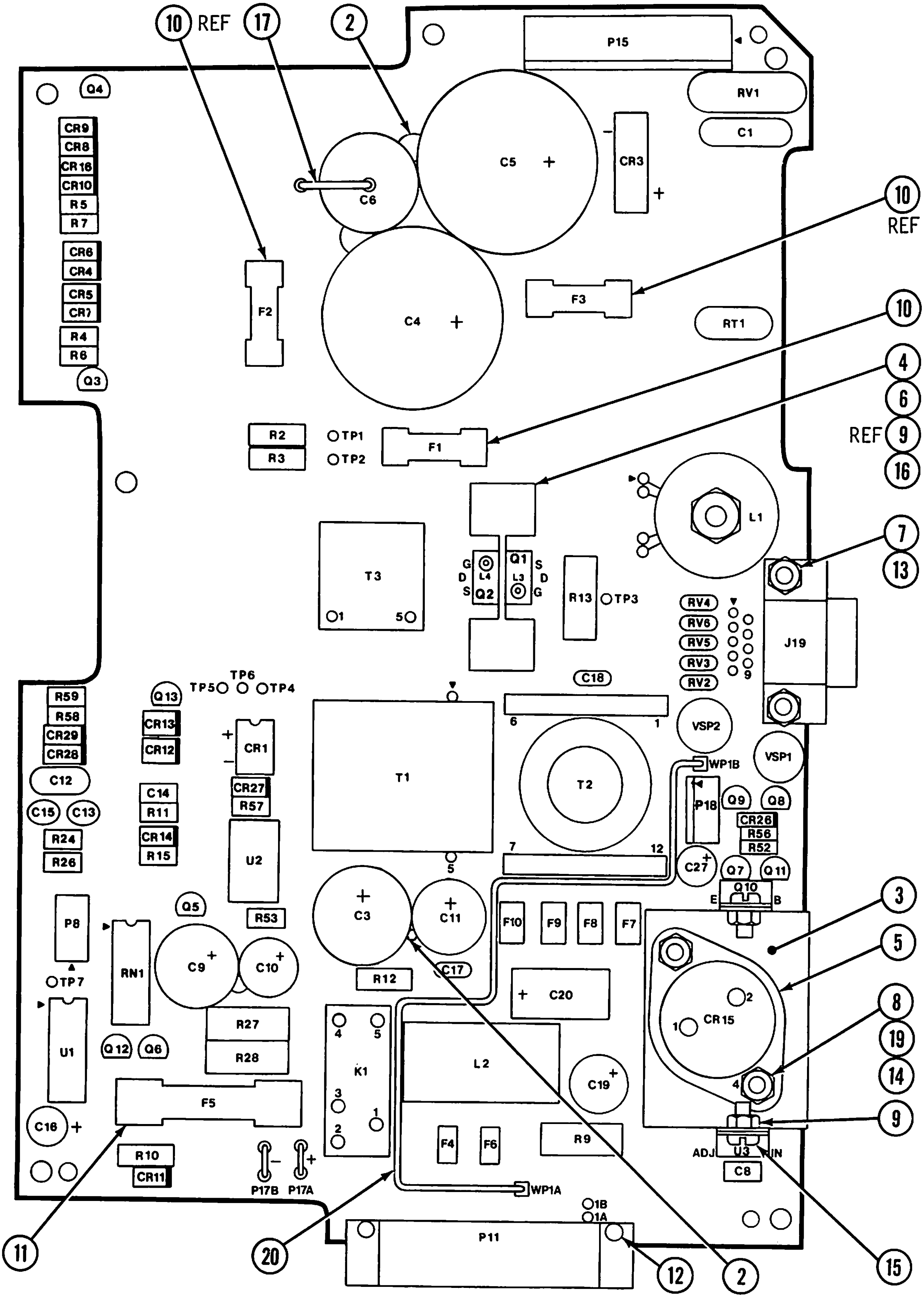
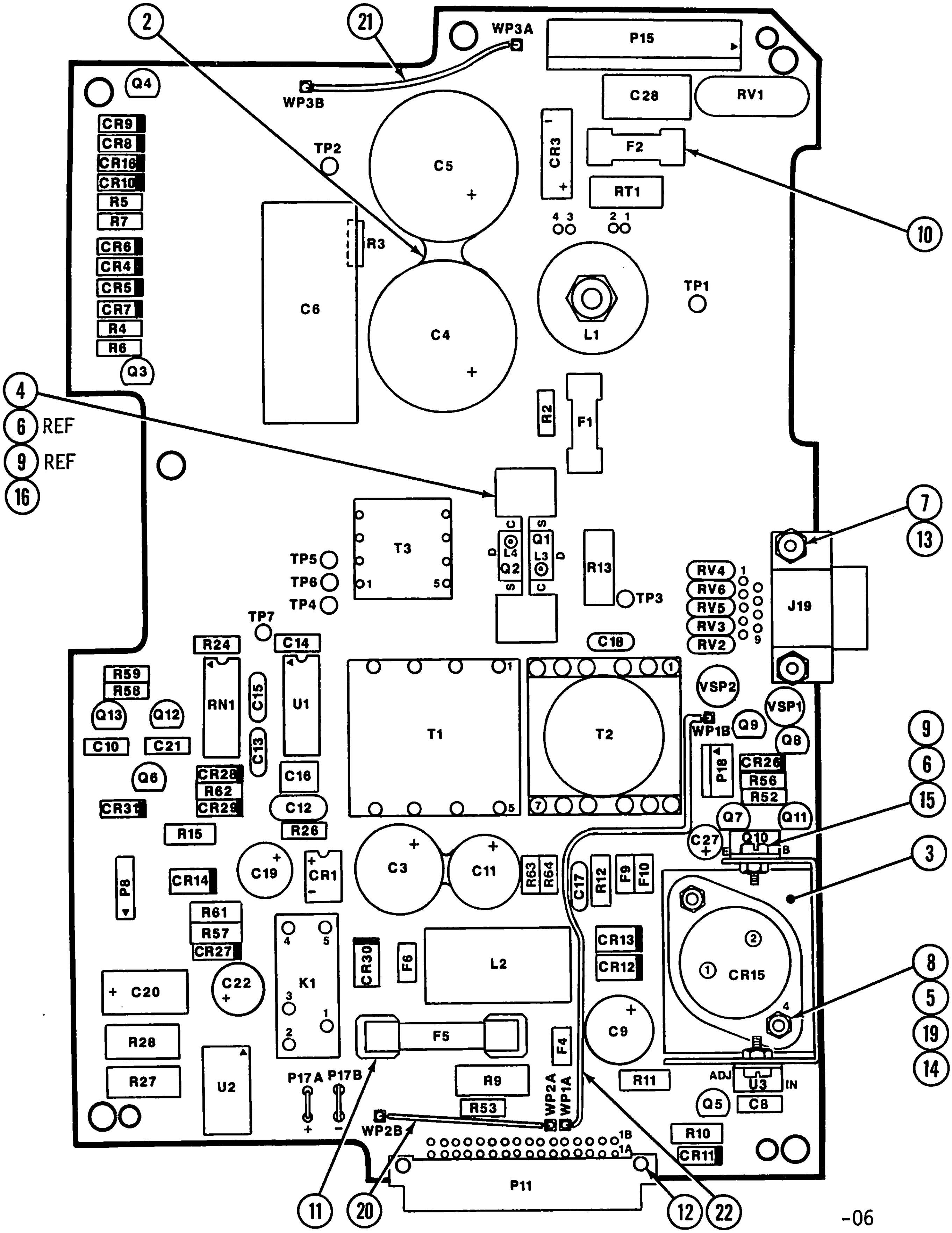

10
REF
17
2
P15
RV1
C1
Q4
CR9
CR8
CR16
CR10
R5
R7
C5
C6
CR3
10
REF
CR6
CR4
CR5
CR7
R4
R6
Q3
F2
C4
F3
RT1
10
4
6
REF 9
16
R2
R3
TP1
TP2
F1
L1
T3
1
5
G
D
S
L4
Q2
Q1
L3
S
D
G
R13
TP3
7
13
RV4
RV6
RV5
RV3
RV2
9
J19
TP6
TP5
TP4
Q13
R59
R58
CR29
CR28
C12
C15
C13
R24
R26
CR13
CR12
C14
R11
CR14
R15
CR1
CR27
R57
U2
R53
T1
C18
6
1
T2
7
12
5
VSP2
VSP1
WP1B
P18
Q9
Q8
CR26
R56
R52
C27
Q7
Q11
Q10
E
B
3
5
C3
C11
F10
F9
F8
F7
P8
RN1
Q5
C9
C10
TP7
R12
C17
C20
CR15
2
1
4
8
19
14
9
U1
Q12
Q6
R27
R28
K1
4
5
3
1
2
L2
C19
F5
C16
F4
F6
R9
ADJ
U3
IN
C8
R10
CR11
P17B
P17A
WP1A
1B
1A
P11
11
20
12
2
15

FIGURE 5-28. POWER SUPPLY PCB ASSEMBLY -02, -04
(SHEET 1 OF 4) 802719


②
㉑
WP3A
P15
Q4
WP3B
C28
RV1
CR9
CR8
CR16
CR10
R5
R7
TP2
C5
CR3
F2
RT1
⑩
CR6
CR4
CR5
CR7
R4
R6
R3
C6
C4
L1
TP1
Q3
④
⑥ REF
⑨ REF
⑯
R2
F1
T3
TP5
TP6
TP4
L4
Q2
Q1
L3
R13
TP3
⑦
⑬
RV4
RV6
RV5
RV3
RV2
J19
TP7
R24
C14
C18
R59
R58
Q13
Q12
RN1
C15
U1
T1
T2
VSP2
VSP1
WP1B
Q9
Q8
⑨
⑥
C10
C21
C13
P18
CR26
R56
R52
⑮
Q6
CR28
R62
CR29
C16
C12
CR31
R15
R26
Q7
Q11
C27
Q10
③
P8
CR14
C19
CR1
C3
C11
R63
R64
C17
R12
F9
F10
R61
R57
CR27
CR30
F6
L2
CR13
CR12
CR15
⑧
⑤
⑲
⑭
C20
C22
K1
C9
F5
F4
R28
R27
U2
P17A
P17B
R9
R53
WP2A
WP1A
R11
ADJ
U3
IN
Q5
C8
WP2B
R10
CR11
1B
1A
P11
⑪
⑳
⑫
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-06
802719

FIGURE 5-28. POWER SUPPLY PCB ASSEMBLY
(SHEET 2 OF 4)

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PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-29				
A1	802715-02	MAIN PCB ASSEMBLY	A	REF
	802715-03	MAIN PCB ASSEMBLY	B	REF
C1	200893-051	. CAPACITOR, 100pF/100V, 10%		3
C3,4	200893-042	. CAPACITOR, .47µF/50V, 10%		3
C5,6		. (Same As C1)		
C7	201628-076	. CAPACITOR, .47µF/50V, 10%		5
C8,9	201628-072	. CAPACITOR, .1µF/50V, 10%		24
C10		. (Same As C7)		
C11,12		. (Same As C8)		
C13	200893-010	. CAPACITOR, 1000pF/50V, 10%	A	3
	200893-010	. CAPACITOR, 1000pF/50V, 10%	B	2
C14-16	200701-021	. CAPACITOR, Electrolytic, 10µF/35V, 20%		5
C17		. (Same As C8)		
C18	200893-018	. CAPACITOR, 4700pF/50V, 10%		1
C19,20	200893-022	. CAPACITOR, .01µF/50V, 10%		3
C21	200205-046	. CAPACITOR, Electrolytic, 2.2µF/50V, 10%		2
C22	200893-014	. CAPACITOR, 2200pF/50V, 10%		1
C23		. (Same As C19)		
C24		. (Same As C21)		
C25	200322-049	. CAPACITOR, Electrolytic, 560µF/20V, +10%		1
C26	200026-000	. CAPACITOR, .01µF/8kV, 10%		1
C27		. (Same As C8)		
C28	200901-163	. CAPACITOR, 5600pF/50V, 10%		2
C29		. (Same As C13)		
C30		. (Same As C8)		
C31		. (Same As C28)		
C32		. (Same As C8)		
C33	201628-015	. CAPACITOR, .33µF/50V, 5%		1
C34-40		. (Same As C8)		
C41	200893-059	. CAPACITOR, 470pF/100V, 10%		2
C42,43		. (Same As C8)		
C44	200701-027	. CAPACITOR, Electrolytic, 220µF/35V, 20%		1
C45		. (Same As C14)		
C46		. (Same As C8)		
C47	200901-034	. CAPACITOR, 1000pF/50V, 10%		1
C48	201628-002	. CAPACITOR, 2.2nF/50V, 10%		1
C49		. (Same As C8)		
C50		. (Same As C14)		
C51	201628-078	. CAPACITOR, 1µF/50V, 10%		1
C52		. (Same As C7)		
C53		. (Same As C13)	A	
	200893-222	. CAPACITOR, .01µF/50V, 20%	B	1
C54-56		. (Same As C8)		
C57	201628-004	. CAPACITOR, 4.7nF/50V, 5%		1
C60,61		. (Same As C7)		
C62	200205-032	. CAPACITOR, Electrolytic, 1000µF/25V, 10%		1
C63		. (Same As C41)		
C64,65		. (Same As C8)		
C67		. (Same As C3)		
CR1	201272-000	. DIODE, 1N3595, 500mA, PIV 100		2
CR2,3	201573-000	. DIODE, 1N4148, 150mA, PIV 100		23
CR4	200510-001	. DIODE, VE18X, Bridge, 1A, PRV 100		1
CR5-13		. (Same As CR2)		
CR14	200086-011	. DIODE, Zener, 1N4625, .2W, 5%, 55mA/5.1V		1
CR15		. (Same As CR2)		
CR16	200083-002	. DIODE, 1N5819, 1A/40V		3
CR17		. (Same As CR2)		
CR18	200881-000	. DIODE, SFES20K, 300nS, PIV 20k		1
CR19	200034-000	. DIODE, Zener, 1N746, 500mW, 230mA/3.3V		1
CR20	200233-152	. DIODE, Zener, 1N5373B, 5W, 5%, 15mA/68V		1
CR21,22	200284-001	. DIODE, 1N4001, 1A/PIV 50		2
CR23-26		. (Same As CR2)		
CR27	200971-000	. DIODE, 1N914B, 8nS, PIV 75		1
CR28		. (Same As CR1)		
CR29		. (Same As CR2)		
CR30	200177-021	. DIODE, Zener, P6KE18A, Transzorb		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-29				
CR31-35		. (Same As CR2)		
CR37,38		. (Same As CR16)		
J10	201678-015	. CONNECTOR, Receptacle, 64 Contact		1
J11	201678-018	. CONNECTOR, Receptacle, 32 Contact		1
L1	200833-013	. INDUCTOR, 500μH, 500mA, 25%		1
L2	200808-000	. INDUCTOR, Ferrite Bead		1
P12	200096-003	. CONNECTOR, Plug, Locking, 5 Contact		1
P13	200534-086	. CONNECTOR, Plug, Locking, 10 Contact		1
P21	201504-003	. TERMINAL, Lug, Quick Disconnect		1
P23	200534-053	. CONNECTOR, Header, 4 Contact		1
Q1	200582-004	. TRANSISTOR, VFET, VCR7N		1
Q2	200585-001	. TRANSISTOR, VFET, VN0106 ATTENTION		1
Q3	200942-001	. TRANSISTOR, NPN, PN2222A		5
Q4,5	200888-001	. TRANSISTOR, PNP, PN2907A		5
Q6		. (Same As Q3)		
Q7		. (Same As Q4)		
Q8		. (Same As Q3)		
Q9	200429-000	. TRANSISTOR, JFET, 2N5116		2
Q10	200387-001	. TRANSISTOR, NPN, MPSA14		2
Q11		. (Same As Q4)		
Q12,13	201231-000	. TRANSISTOR, NPN, MJE223		2
Q14	201236-000	. TRANSISTOR, NPN, 2N6274		1
Q15		. (Same As Q3)		
Q16	201221-000	. TRANSISTOR, PNP, MPS6651		2
Q17	201197-000	. TRANSISTOR, NPN, D44VH1		2
Q18		. (Same As Q10)		
Q19		. (Same As Q16)		
Q20		. (Same As Q17)		
Q21		. (Same As Q9)		
Q23,24	201738-000	. TRANSISTOR, FET, VP0104, P-Channel ATTENTION		2
Q25	200994-003	. TRANSISTOR, FET, IRF9533, P-Channel ATTENTION		1
Q26		. (Same As Q4)		
Q27		. (Same As Q3)		
R2,3	200054-575	. RESISTOR, 10 MΩ, 1/8W, 1%, RN55C		6
R5	200054-250	. RESISTOR, 4.02 kΩ, 1/8W, 1%, RN55C		1
R6	200054-480	. RESISTOR, 1 MΩ, 1/8W, 1%, RN55C	A	9
	200054-480	. RESISTOR, 1 MΩ, 1/8W, 1%, RN55C	B	8
R9	200054-284	. RESISTOR, 9.09 kΩ, 1/8W, 1%, RN55C		1
R10		. (Same As R6)		
R11	200054-281	. RESISTOR, 8.45 kΩ, 1/8W, 1%, RN55C		1
R12	200527-006	. POTENTIOMETER, 1 kΩ, 1/2W, 10%, Multi-Turn		1
R13	200054-424	. RESISTOR, 261 kΩ, 1/8W, 1%, RN55C		1
R14	200054-426	. RESISTOR, 274 kΩ, 1/8W, 1%, RN55C		1
R15	200054-508	. RESISTOR, 2 MΩ, 1/8W, 1%, RN55C		2
R16	200054-417	. RESISTOR, 221 kΩ, 1/8W, 1%, RN55C		1
R17	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C	A	11
	200054-384	. RESISTOR, 100 kΩ, 1/8W, 1%, RN55C	B	12
R18	200471-076	. RESISTOR, 1.5 kΩ, 1/2W, 5%		1
R19	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C	A	4
	200054-193	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C	B	3
R20		. (Same As R19)	A	
		. (Same As R23)	B	
R21		. (Same As R17)		
R22	200054-344	. RESISTOR, 38.3 kΩ, 1/8W, 1%, RN55C		1
R23	200054-249	. RESISTOR, 3.92 kΩ, 1/8W, 1%, RN55C	A	1
	200054-249	. RESISTOR, 3.92 kΩ, 1/8W, 1%, RN55C	B	2
R24	200054-305	. RESISTOR, 15 kΩ, 1/8W, 1%, RN55C		2
R25,26	200503-012	. POTENTIOMETER, 50 kΩ, 1/2W, 20%, 1 Turn		2
R27-29	200054-173	. RESISTOR, 619 Ω, 1/8W, 1%, RN55C		3
R30	200471-067	. RESISTOR, 620 Ω, 1/2W, 5%		1
R31	200470-054	. RESISTOR, 180 Ω, 1/4W, 5%		1
R32	200471-041	. RESISTOR, 51 Ω, 1/2W, 5%		1
R33	200270-028	. RESISTOR, 1.5 Ω, 2W, 5%		1

PARTS LIST

FIG-ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	USE CODE	QTY
5-29				
R34	200054-069	. RESISTOR, 51.1 Ω, 1/8W, 1%		1
R35	200054-330	. RESISTOR, 27.4 kΩ, 1/8W, 1%		1
R36		. (Same As R24)		
R37	200054-288	. RESISTOR, 10 kΩ, 1/8W, 1%, RN55C		4
R38,39	801884-00	. RESISTOR, 64 MΩ, 1W, 1%		2
R40	201833-000	. RESISTOR, 1 kΩ, 2W, 1%	A	1
	200257-048	. RESISTOR, 1 kΩ, 2W, 5%	B	1
R41	200270-078	. RESISTOR, 180 Ω, 2W, 5%		2
R42	200270-054	. RESISTOR, 18 Ω, 2W, 5%		2
R43		. (Same As R41)		
R44		. (Same As R42)		
R45	200470-114	. RESISTOR, 56 kΩ, 1/4W, 5%		1
R46		. (Same As R6)		
R48		. (Same As R19)		
R49,50		. (Same As R6)		
R51	200054-321	. RESISTOR, 1 kΩ, 1/8W, 1%, RN55C		1
R52	200054-339	. RESISTOR, 34 kΩ, 1/8W, 1%, RN55C		1
R53		. (Same As R37)		
R54	200054-424	. RESISTOR, 261 kΩ, 1/8W, 1%, RN55C		1
R55		. (Same As R2)		
R56	200470-024	. RESISTOR, 10 Ω, 1/4W, 5%		1
R57	200054-253	. RESISTOR, 4.32 kΩ, 1/8W, 1%, RN55C		1
R58		. (Same As R17)		
R59		. (Same As R15)		
R60	200054-357	. RESISTOR, 52.3 kΩ, 1/8W, 1%, RN55C		2
R61,62		. (Same As R17)		
R63		. (Same As R19)		
R64		. (Same As R17)		
R65		. (Same As R2)		
R66,67		. (Same As R6)		
R68		. (Same As R37)		
R69		. (Same As R2)		
R74		. (Same As R17)		
R75	200054-440	. RESISTOR, 383 kΩ, 1/8W, 1%, RN55C		1
R76	200054-259	. RESISTOR, 4.99 kΩ, 1/8W, 1%, RN55C		1
R77		. (Same As R37)		
R78		. (Same As R2)		
R79		. (Same As R17)		
R80		. (Same As R6)		
R81-83		. (Same As R17)		
R84	200054-328	. RESISTOR, 26.1 kΩ, 1/8W, 1%, RN55C		1
R85	200054-417	. RESISTOR, 221 kΩ, 1/8W, 1%		1
R86		. (Same As R60)		
R87		. (Same As R6)	A	
		. (Same As R17)	B	
R88	200054-402	. RESISTOR, 154 kΩ, 1/8W, 1%, RN55C	A	1
	200054-307	. RESISTOR, 15.8 kΩ, 1/8W, 1%, RN55C	B	1
R89,90	200054-257	. RESISTOR, 4.75 kΩ, 1/8W, 1%, RN55C		2
R91	200470-062	. RESISTOR, 390 Ω, 1/4W, 5%	B	1
R92	200470-127	. RESISTOR, 200 kΩ, 1/4W, 5%	B	1
RN1,2	201240-018	. RESISTOR NETWORK, 4 X 100 kΩ, 1/3W, 5%		7
RN3	201240-015	. RESISTOR NETWORK, 4 X 33 kΩ, 1/3W, 5%		1
RN4	201240-010	. RESISTOR NETWORK, 4 X 4.7 kΩ, 1/3W, 5%		1
RN5		. (Same As RN1)		
RN6	201240-001	. RESISTOR NETWORK, 4 X 150 Ω, 1/3W, 5%		2
RN8	200043-074	. RESISTOR NETWORK, 8 X 33 kΩ, 1.5W, 2%		1
RN9	201240-009	. RESISTOR NETWORK, 4 X 3.3 kΩ, 1/3W, 5%		1
RN10	201240-006	. RESISTOR NETWORK, 4 X 1 kΩ, 1/3W, 5%		1
RN11		. (Same As RN6)		
RN12		. (Same As RN1)		
RN13	201832-007	. RESISTOR NETWORK, 4 X 20 kΩ, 1/2W, 1%		1
RN14		. (Same As RN1)		
RN15	201240-012	. RESISTOR NETWORK, 4 X 10 kΩ, 1/3W, 5%		1
RN16	200422-038	. RESISTOR NETWORK, 7 X 10 kΩ, 1.1W, 2%		1
RN17,18		. (Same As RN1)		
RN19	201832-008	. RESISTOR NETWORK, 4 X 50 kΩ, 1/2W, 1%		1

SECTION 6
COMPONENT REFERENCE DIAGRAMS

6-1. OVERVIEW

This section provides information about selected components in the LIFEPAK 8. The pin configurations, function tables and block diagrams are provided as reference material for analyzing circuits and troubleshooting. Figures 6-1 to 6-48 are arranged alphabetically by IC type.

TABLE 6-1

LP 8 COMPONENT REFERENCE DIAGRAMS

LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
MONITOR				
Anode Supply (A8)	U2	555	Timer	6-45
Charger (A3)	U1	3525A	Pulse Width Modulator	6-36
Control (A6)	U1,U36 ⚠	4053BCN	Multiplexer/Demultiplexer	6-31
	U2,U8 ⚠	74HC138	Decoder	6-15
	U4,U7, U19 ⚠	74HC245	Transceiver	6-47
	U5,U60 ⚠	74HC125	Buffer	6-3
	U6 ⚠	6303	Microprocessor	6-29
	U9 ⚠	74HC73	Flip-Flop, J-K	6-21
	U13,U23 ⚠	211CJ	Switch,Analog	6-41
	U15 ⚠	27C64	EPROM	6-18
	U16,U18 ⚠	74HC373	Latch	6-27
	U17,U31, U35,U61 ⚠	74HC374	Flip-Flop,D type	6-24
	U27 ⚠	4020	Counter	6-11
	U30 ⚠	ADC0805	Converter,A/D	6-8
	U31 ⚠	74HC175	Flip-Flop,D type	6-23
	U47,U63 U64 ⚠	UP446-2C	RAM,Static,2K X 8	6-37

TABLE 6-1 (Continued)

LP 8 COMPONENT REFERENCE DIAGRAMS

LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
Control (Cont'd)	U49 ⚠		Gate Array,Raster Controller	6-26
	U50 ⚠	1834CE	ROM	6-40
	U58 ⚠		Gate Array,No Fade	6-25
	U65 ⚠	7528	Converter,D/A	6-10
CRT (A7)	U2 ⚠	4053BCN	Multiplexer/Demultiplexer	6-31
ECG (A4)	U4,U10, U14,U36 ⚠	303	Switch,Analog	6-43
	U5 ⚠	307	Switch,Analog	6-43
	U6	3525A	Pulse Width Modulator	6-36
	U9 ⚠	211	Switch,Analog	6-41
	U17 ⚠	7528	Converter,D/A	6-10
	U19 ⚠	6301	Microprocessor	6-28
	U29 ⚠	7574	Converter,A/D	6-9
	U34 ⚠	4046	Phase Locked Loop	6-35
	U38-U40 ⚠	508A	Switch,Analog	6-44
Gateway (A5)	U1 ⚠	6303	Microprocessor	6-29
	U2,U3 ⚠	6350	ACIA (UART)	6-1
	U4 ⚠	27C64	EPROM	6-18
	U6 ⚠	74HC373	Latch	6-27
	U7 ⚠	74HC245	Transceiver	6-47
	U8 ⚠	74HC138	Decoder	6-15
	U13 ⚠	74HC4020	Counter	6-13
	U18 ⚠	74HC76	Flip-Flop,J-K	6-22
Power Supply (A2)	U2 ⚠	4013B	Flip-Flop,D type	6-19
	U23,U30 ⚠	4024	Counter	6-12
	U26,U102 ⚠	4047	Timer	6-46

TABLE 6-1 (Continued)

LP 8 COMPONENT REFERENCE DIAGRAMS

LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
Power Supply (Cont'd)	U27 ⚠	74HC74	Flip-Flop,D type	6-20
	U28,U29 ⚠	74HC221	Multivibrator	6-33
	U201	TBA820	Audio Amp	6-2
Recorder (A9)	U5 ⚠	DG243	Switch,Analog	6-42
	U6 ⚠	74HC374	Flip-Flop,D type	6-24
	U8 ⚠	146818	Clock	6-5
	U11 ⚠	74HC221	Multivibrator	6-33
DEFIBRILLATOR				
Logic (A8)	U1,U18 ⚠	6301	Microprocessor	6-28
	U2 ⚠	TLC541	Converter,A/D	6-6
	U7 ⚠	4538B	Multivibrator,Monostable	6-32
	U8 ⚠	4555	Decoder/Demultiplexer	6-17
	U19 ⚠	ADC0804	Converter,A/D	6-7
	U20,U21 ⚠	74HC165	Register	6-38
	U22 ⚠	74HC4040	Counter	6-14
	U23 ⚠	CD4094	Register/Latch	6-39
	U24 ⚠	CD4051BE	Multiplexer/Demultiplexer	6-30
	U29,30 ⚠	74HC244	Buffer	6-4
	U32 ⚠	4013B	Flip-Flop,D type	6-19
Lower Switch Module (A7)	U1 ⚠	74C48	Decoder	6-16
Main (A1)	U3,U18 ⚠	CD4046	Phase Locked Loop	6-35
	U11	TL494CN	Voltage Regulator,Switching	6-48
	U13,U23 ⚠	CD4053	Multiplexer/Demultiplexer	6-31
	U15	NE555	Timer	6-45
	U19 ⚠	CD4013	Flip-Flop,D type	6-19
Power Supply (A2)	U1	3525A	Pulse Width Modulator	6-36

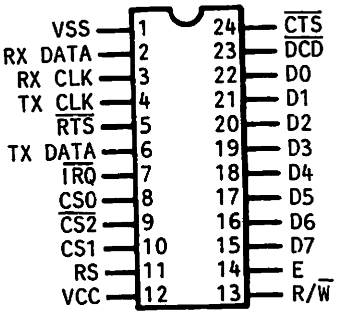
TABLE 6-1 (Continued)

LP 8 COMPONENT REFERENCE DIAGRAMS

LOCATION	REF. DES.	IC NUMBER	TYPE	FIG. NO
PACING CASSETTE				
Pacing	U1 ⚠	4020	Counter	6-11
Cassette	U9 ⚠	6301	Microprocessor	6-28
PFC	U11	3525A	Pulse Width Modulator	6-36
(A2)	U13 ⚠	74HC4538	Multivibrator,Monostable	6-34

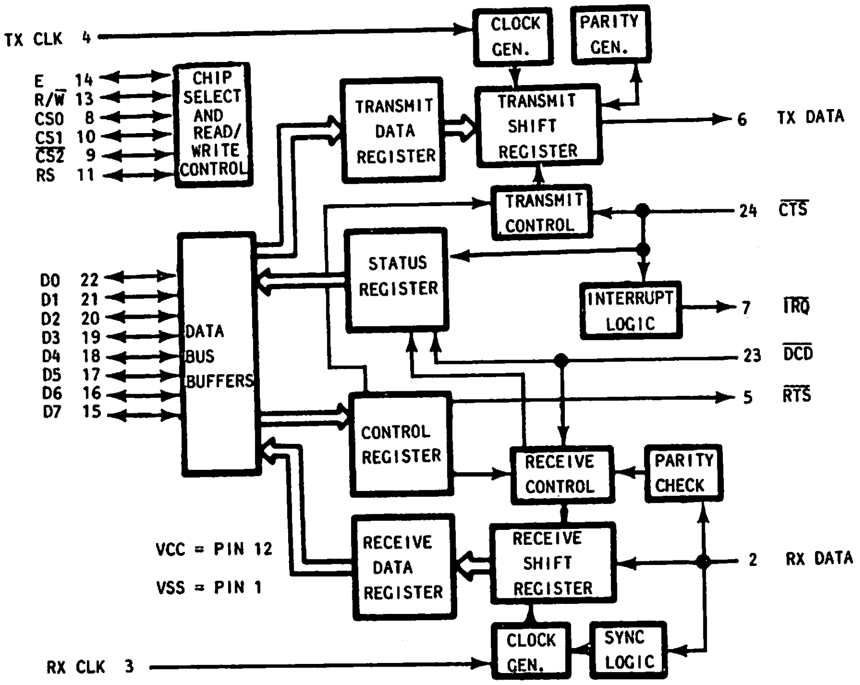
TYPE	IC NUMBER	LOCATION	REF. DES.
ACIA	6350	GATEWAY (A5)	U2,U3

ATTENTION



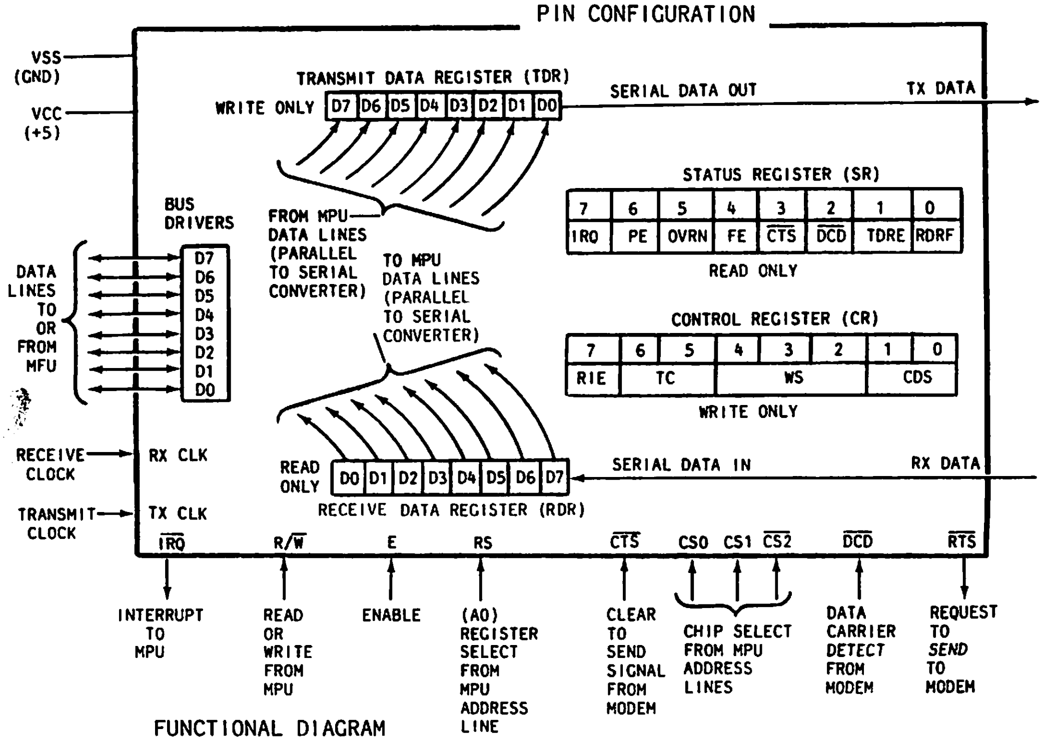
VSS 1
RX DATA 2
RX CLK 3
TX CLK 4
$\overline{RTS}$ 5
TX DATA 6
$\overline{IRQ}$ 7
$\overline{CS0}$ 8
$\overline{CS2}$ 9
CS1 10
RS 11
VCC 12
13 R/$\overline{W}$
14 E
15 D7
16 D6
17 D5
18 D4
19 D3
20 D2
21 D1
22 D0
23 $\overline{DCD}$
24 $\overline{CTS}$

PIN CONFIGURATION



TX CLK 4
CLOCK GEN.
PARITY GEN.
E 14
R/$\overline{W}$ 13
CS0 8
CS1 10
$\overline{CS2}$ 9
RS 11
CHIP SELECT AND READ/WRITE CONTROL
TRANSMIT DATA REGISTER
TRANSMIT SHIFT REGISTER
6 TX DATA
TRANSMIT CONTROL
24 $\overline{CTS}$
STATUS REGISTER
INTERRUPT LOGIC
7 $\overline{IRQ}$
D0 22
D1 21
D2 20
D3 19
D4 18
D5 17
D6 16
D7 15
DATA BUS BUFFERS
23 $\overline{DCD}$
5 $\overline{RTS}$
CONTROL REGISTER
RECEIVE CONTROL
PARITY CHECK
VCC = PIN 12
VSS = PIN 1
RECEIVE DATA REGISTER
RECEIVE SHIFT REGISTER
2 RX DATA
RX CLK 3
CLOCK GEN.
SYNC LOGIC

BLOCK DIAGRAM

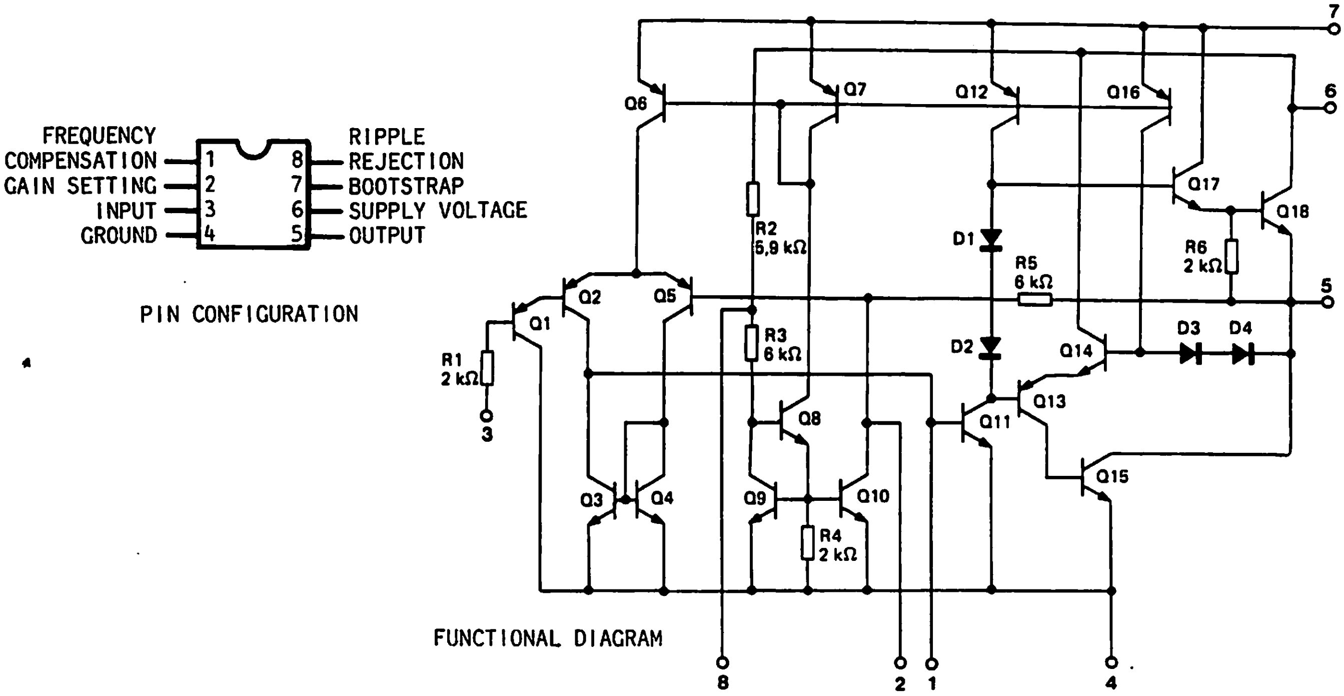


PIN CONFIGURATION
VSS (GND)
VCC (+5)
TRANSMIT DATA REGISTER (TDR)
WRITE ONLY
D7 D6 D5 D4 D3 D2 D1 D0
SERIAL DATA OUT
TX DATA
BUS DRIVERS
FROM MPU DATA LINES (PARALLEL TO SERIAL CONVERTER)
TO MPU DATA LINES (PARALLEL TO SERIAL CONVERTER)
DATA LINES TO OR FROM MFU
D7 D6 D5 D4 D3 D2 D1 D0
STATUS REGISTER (SR)
7 6 5 4 3 2 1 0
IRQ PE OVRN FE $\overline{CTS}$ $\overline{DCD}$ TDRE RDRF
READ ONLY
CONTROL REGISTER (CR)
7 6 5 4 3 2 1 0
RIE TC WS CDS
WRITE ONLY
RECEIVE CLOCK
RX CLK
TRANSMIT CLOCK
TX CLK
READ ONLY
D0 D1 D2 D3 D4 D5 D6 D7
RECEIVE DATA REGISTER (RDR)
SERIAL DATA IN
RX DATA
$\overline{IRQ}$
R/$\overline{W}$
E
RS
$\overline{CTS}$
CS0 CS1 $\overline{CS2}$
$\overline{DCD}$
$\overline{RTS}$
INTERRUPT TO MPU
READ OR WRITE FROM MPU
ENABLE
(A0) REGISTER SELECT FROM MPU ADDRESS LINE
CLEAR TO SEND SIGNAL FROM MODEM
CHIP SELECT FROM MPU ADDRESS LINES
DATA CARRIER DETECT FROM MODEM
REQUEST TO SEND TO MODEM

FUNCTIONAL DIAGRAM

FIGURE 6-1.

TYPE	IC NUMBER	LOCATION	REF. DES.
AUDIO AMP	TBA820	POWER SUPPLY (A2) Monitor	U201


FREQUENCY COMPENSATION
GAIN SETTING
INPUT
GROUND
1
2
3
4
8
7
6
5
RIPPLE REJECTION
BOOTSTRAP
SUPPLY VOLTAGE
OUTPUT
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
R1 2 kΩ
R2 5,8 kΩ
R3 6 kΩ
R4 2 kΩ
R5 6 kΩ
R6 2 kΩ
D1
D2
D3
D4
7
6
5
3
8
2
1
4

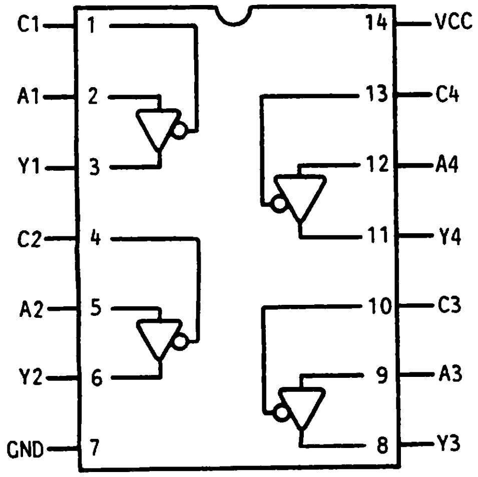
PIN CONFIGURATION

FUNCTIONAL DIAGRAM

FIGURE 6-2.

TYPE	IC NUMBER	LOCATION	REF. DES.
BUFFER	74HC125	CONTROL (A6)	U5,U60

ATTENTION


C1
A1
Y1
C2
A2
Y2
GND
1
2
3
4
5
6
7
14
13
12
11
10
9
8
VCC
C4
A4
Y4
C3
A3
Y3

CONNECTION DIAGRAM

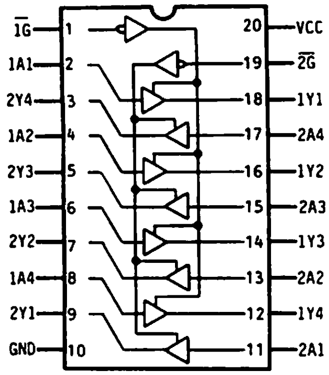
INPUTS		OUTPUT
A	C	Y
H	L	H
L	L	L
X	H	HI-Z

Y = A
H = High level
L = Low level
X = Irrelevant

FUNCTION TABLE

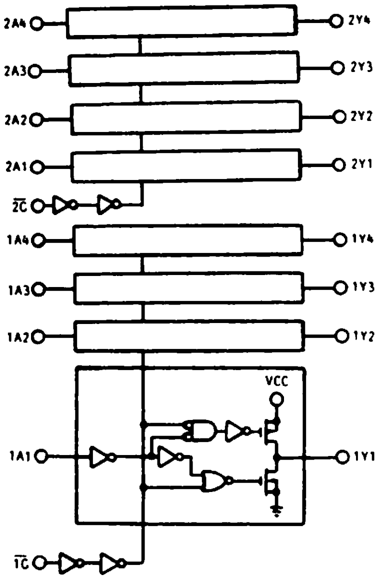
FIGURE 6-3.

TYPE	IC NUMBER	LOCATION	REF. DES.
BUFFER	74HC244	LOGIC (A8)	U29, U30



$\overline{1G}$ 1
1A1 2
2Y4 3
1A2 4
2Y3 5
1A3 6
2Y2 7
1A4 8
2Y1 9
GND 10
20 VCC
19 $\overline{2G}$
18 1Y1
17 2A4
16 1Y2
15 2A3
14 1Y3
13 2A2
12 1Y4
11 2A1

CONNECTION DIAGRAM



2A4
2A3
2A2
2A1
$\overline{2C}$
1A4
1A3
1A2
1A1
$\overline{1C}$
2Y4
2Y3
2Y2
2Y1
1Y4
1Y3
1Y2
1Y1
VCC

FUNCTIONAL DIAGRAM

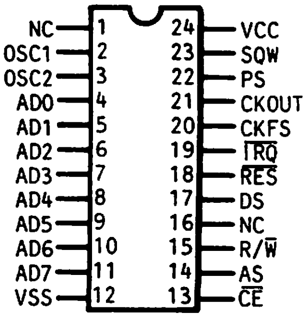
$\overline{1G}$	1A	1Y	$\overline{2G}$	2A	2Y
L	L	L	L	L	L
L	H	H	L	H	H
H	L	Z	H	L	Z
H	H	Z	H	H	Z

H = High level
L = Low level
Z = High impedance output state

FUNCTION TABLE

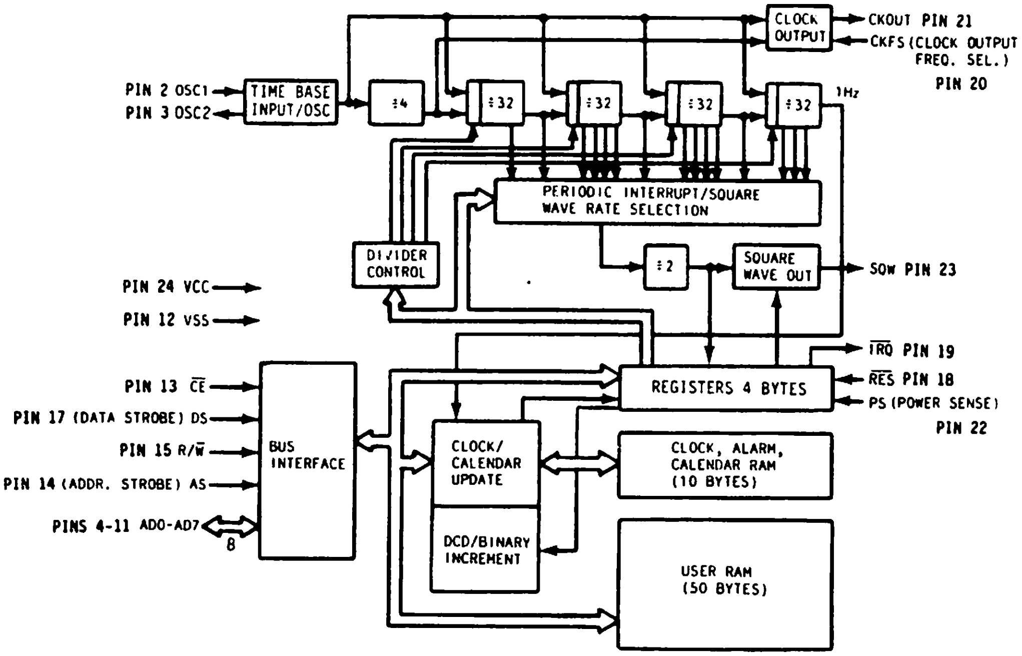
FIGURE 6-4.

TYPE	IC NUMBER	LOCATION	REF. DES.
CLOCK, R.T. W/RAM	146818	RECORDER (A9)	U8



NC 1
OSC1 2
OSC2 3
AD0 4
AD1 5
AD2 6
AD3 7
AD4 8
AD5 9
AD6 10
AD7 11
VSS 12
24 VCC
23 SQW
22 PS
21 CKOUT
20 CKFS
19 $\overline{IRQ}$
18 $\overline{RES}$
17 DS
16 NC
15 R/$\overline{W}$
14 AS
13 $\overline{CE}$

PIN CONFIGURATION

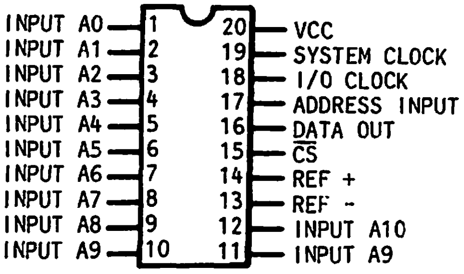


CLOCK OUTPUT
CKOUT PIN 21
CKFS (CLOCK OUTPUT FREQ. SEL.) PIN 20
PIN 2 OSC1
PIN 3 OSC2
TIME BASE INPUT/OSC
÷4
÷32
÷32
÷32
÷32
1Hz
PERIODIC INTERRUPT/SQUARE WAVE RATE SELECTION
DIVIDER CONTROL
÷2
SQUARE WAVE OUT
SQW PIN 23
PIN 24 VCC
PIN 12 VSS
$\overline{IRQ}$ PIN 19
$\overline{RES}$ PIN 18
PS (POWER SENSE) PIN 22
PIN 13 $\overline{CE}$
PIN 17 (DATA STROBE) DS
PIN 15 R/$\overline{W}$
PIN 14 (ADDR. STROBE) AS
PINS 4-11 AD0-AD7
8
BUS INTERFACE
REGISTERS 4 BYTES
CLOCK/ CALENDAR UPDATE
CLOCK, ALARM, CALENDAR RAM (10 BYTES)
DCD/BINARY INCREMENT
USER RAM (50 BYTES)

BLOCK DIAGRAM

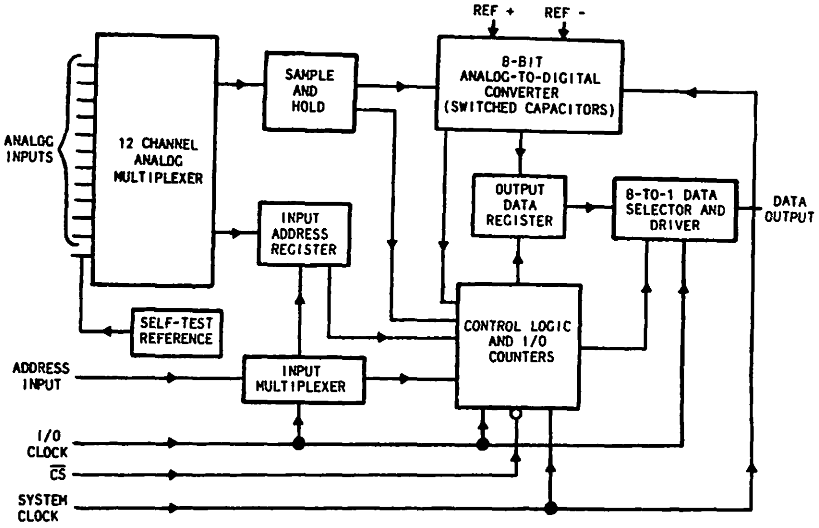
FIGURE 6-5.

TYPE	IC NUMBER	LOCATION	REF. DES.
CONVERTER, A/D	TLC541	LOGIC (A8)	U2



INPUT A0 1
INPUT A1 2
INPUT A2 3
INPUT A3 4
INPUT A4 5
INPUT A5 6
INPUT A6 7
INPUT A7 8
INPUT A8 9
INPUT A9 10
20 VCC
19 SYSTEM CLOCK
18 I/O CLOCK
17 ADDRESS INPUT
16 DATA OUT
15 $\overline{CS}$
14 REF +
13 REF -
12 INPUT A10
11 INPUT A9

PIN CONFIGURATION

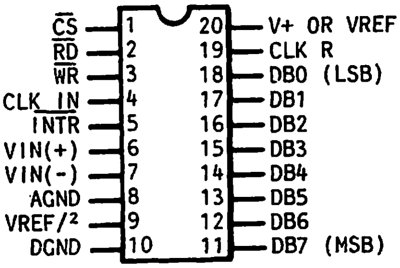


REF +
REF -
8-BIT ANALOG-TO-DIGITAL CONVERTER (SWITCHED CAPACITORS)
SAMPLE AND HOLD
ANALOG INPUTS
12 CHANNEL ANALOG MULTIPLEXER
OUTPUT DATA REGISTER
8-TO-1 DATA SELECTOR AND DRIVER
DATA OUTPUT
INPUT ADDRESS REGISTER
SELF-TEST REFERENCE
CONTROL LOGIC AND I/O COUNTERS
ADDRESS INPUT
INPUT MULTIPLEXER
I/O CLOCK
$\overline{CS}$
SYSTEM CLOCK

BLOCK DIAGRAM

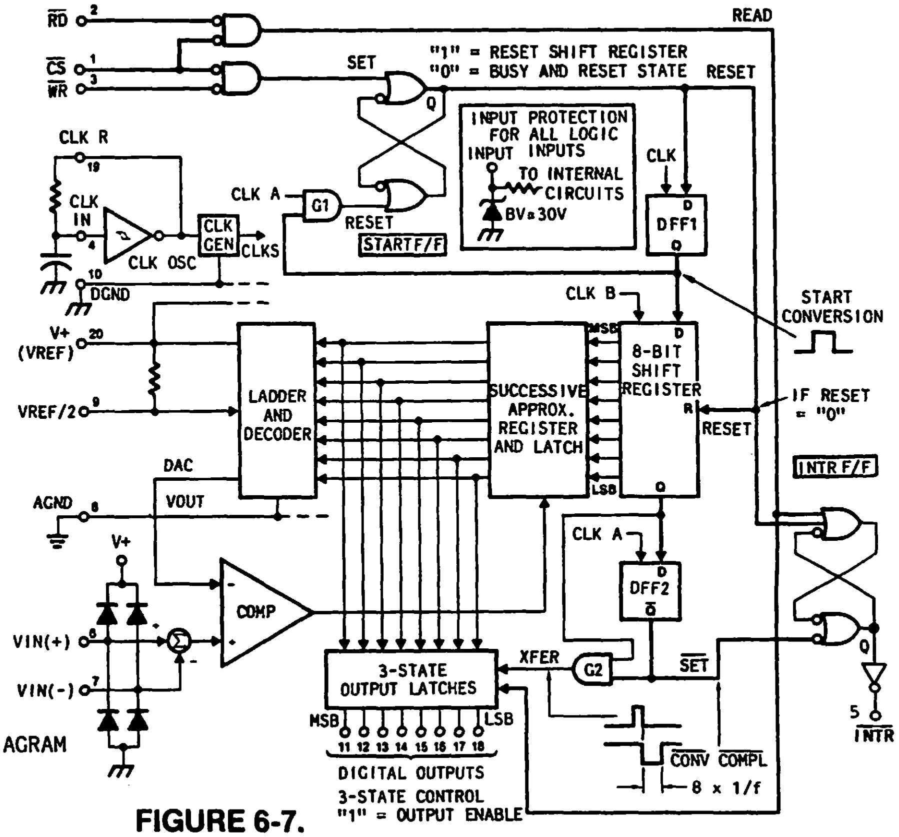
FIGURE 6-6.

TYPE	IC NUMBER	LOCATION	REF. DES.
CONVERTER, A/D	ADC0804	LOGIC (A8)	U19



$\overline{CS}$ 1
$\overline{RD}$ 2
$\overline{WR}$ 3
CLK IN 4
$\overline{INTR}$ 5
VIN(+) 6
VIN(-) 7
AGND 8
VREF/2 9
DGND 10
20 V+ OR VREF
19 CLK R
18 DB0 (LSB)
17 DB1
16 DB2
15 DB3
14 DB4
13 DB5
12 DB6
11 DB7 (MSB)

PIN CONFIGURATION

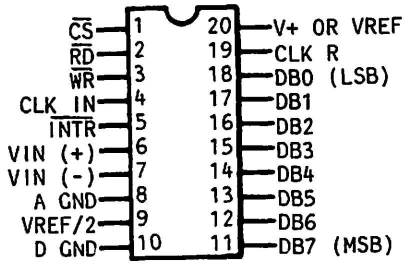


$\overline{RD}$ 2
$\overline{CS}$ 1
$\overline{WR}$ 3
READ
SET
"1" = RESET SHIFT REGISTER
"0" = BUSY AND RESET STATE
RESET
Q
INPUT PROTECTION FOR ALL LOGIC INPUTS
INPUT
TO INTERNAL CIRCUITS
BV=30V
CLK
D
DFF1
Q
CLK R
19
CLK IN
4
CLK OSC
CLK GEN
CLKS
CLK A
G1
RESET
START F/F
10
DGND
CLK B
START CONVERSION
V+ 20
(VREF)
VREF/2 9
LADDER AND DECODER
MSB
SUCCESSIVE APPROX. REGISTER AND LATCH
8-BIT SHIFT REGISTER
D
R
RESET
LSB
Q
IF RESET = "0"
INTR F/F
DAC
AGND 8
VOUT
V+
CLK A
D
DFF2
$\overline{Q}$
COMP
VIN(+) 6
VIN(-) 7
Σ
3-STATE OUTPUT LATCHES
XFER
G2
$\overline{SET}$
Q
5
$\overline{INTR}$
MSB
LSB
11 12 13 14 15 16 17 18
DIGITAL OUTPUTS
3-STATE CONTROL
"1" = OUTPUT ENABLE
$\overline{CONV}$ $\overline{COMPL}$
8 x 1/f

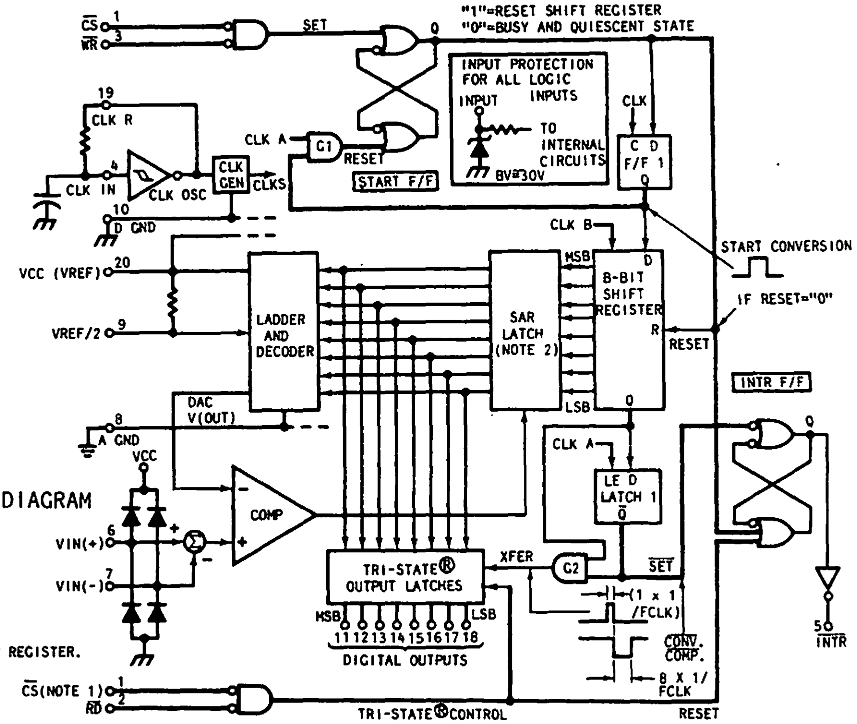
FUNCTIONAL DIAGRAM

FIGURE 6-7.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
CONVERTER, A/D	ADC0805	CONTROL (A6)	U30



CS 1
RD 2
WR 3
CLK IN 4
INTR 5
VIN (+) 6
VIN (-) 7
A GND 8
VREF/2 9
D GND 10
20 V+ OR VREF
19 CLK R
18 DB0 (LSB)
17 DB1
16 DB2
15 DB3
14 DB4
13 DB5
12 DB6
11 DB7 (MSB)



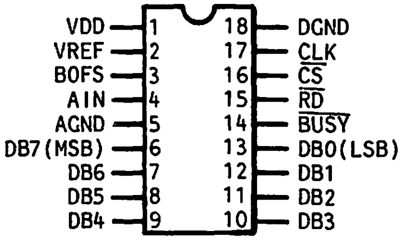
CS
WR
SET
Q
"1"=RESET SHIFT REGISTER
"0"=BUSY AND QUIESCENT STATE
INPUT PROTECTION FOR ALL LOGIC INPUTS
INPUT
TO INTERNAL CIRCUITS
BV≅30V
CLK
C D
F/F 1
Q
CLK R
CLK A
G1
RESET
START F/F
CLK IN
CLK OSC
CLK GEN
CLKS
D GND
CLK B
START CONVERSION
VCC (VREF)
VREF/2
LADDER AND DECODER
SAR LATCH (NOTE 2)
MSB
LSB
8-BIT SHIFT REGISTER
D
R
RESET
IF RESET="0"
INTR F/F
DAC V(OUT)
A GND
VCC
CLK A
LE D LATCH 1
Q
VIN(+)
VIN(-)
Σ
COMP
TRI-STATE® OUTPUT LATCHES
XFER
G2
SET
MSB
LSB
11 12 13 14 15 16 17 18
DIGITAL OUTPUTS
(1 x 1/FCLK)
CONV. COMP.
8 X 1/FCLK
INTR
CS(NOTE 1)
RD
TRI-STATE® CONTROL "1"=OUTPUT ENABLE
RESET

BLOCK DIAGRAM

NOTE 1: CS SHOWN TWICE FOR CLARITY.
NOTE 2: SAR = SUCCESSIVE APPROXIMATION REGISTER.

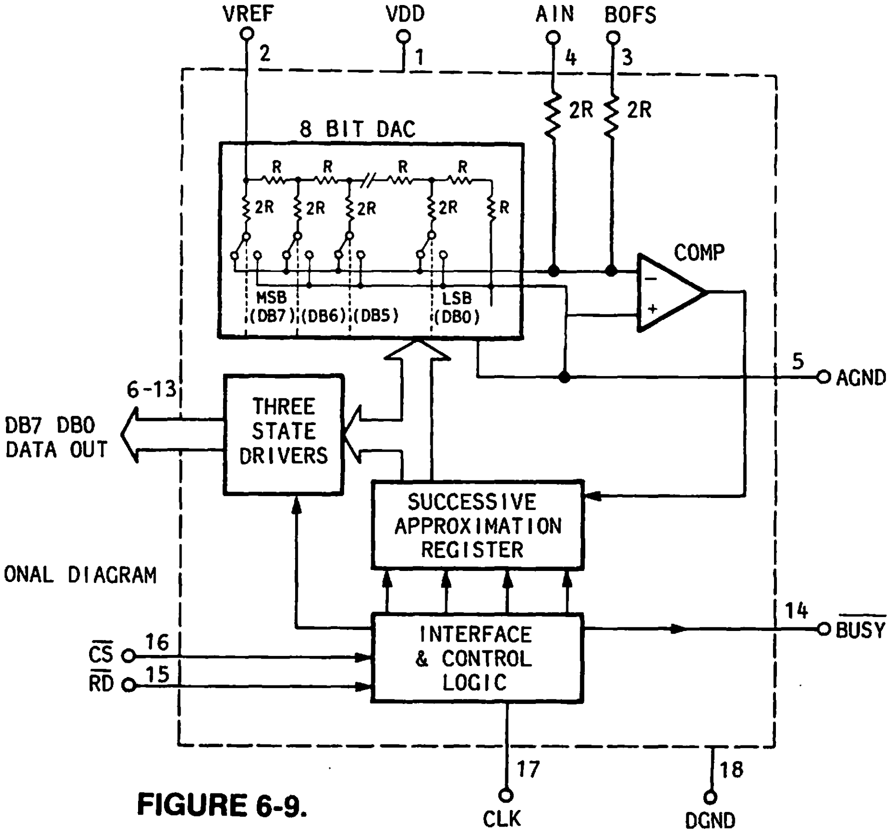
FIGURE 6-8.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
CONVERTER, A/D	7574	ECG (A4)	U29



VDD 1
VREF 2
BOFS 3
AIN 4
AGND 5
DB7 (MSB) 6
DB6 7
DB5 8
DB4 9
18 DGND
17 CLK
16 CS
15 RD
14 BUSY
13 DB0(LSB)
12 DB1
11 DB2
10 DB3

PIN CONFIGURATION

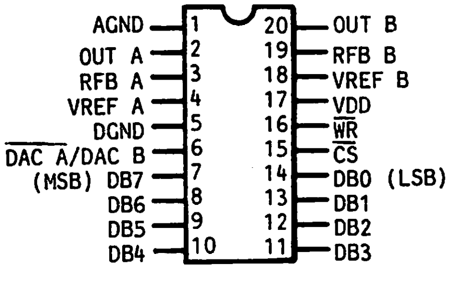


VREF 2
VDD 1
AIN 4
BOFS 3
2R
2R
8 BIT DAC
R
R
R
R
2R
2R
2R
2R
R
MSB (DB7)
(DB6)
(DB5)
LSB (DB0)
COMP
5 AGND
6-13
DB7 DB0 DATA OUT
THREE STATE DRIVERS
SUCCESSIVE APPROXIMATION REGISTER
INTERFACE & CONTROL LOGIC
CS 16
RD 15
14 BUSY
17 CLK
18 DGND

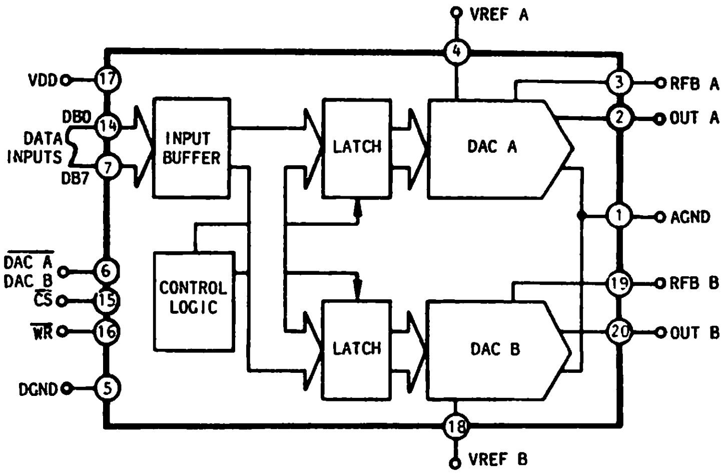
FUNCTIONAL DIAGRAM

FIGURE 6-9.

TYPE	IC NUMBER	LOCATION	REF. DES.
CONVERTER, D/A	7528	CONTROL (A6)	U65
		ECG (A4)	U17


AGND 1
OUT A 2
RFB A 3
VREF A 4
DGND 5
DAC A/DAC B 6
(MSB) DB7 7
DB6 8
DB5 9
DB4 10
20 OUT B
19 RFB B
18 VREF B
17 VDD
16 WR
15 CS
14 DB0 (LSB)
13 DB1
12 DB2
11 DB3

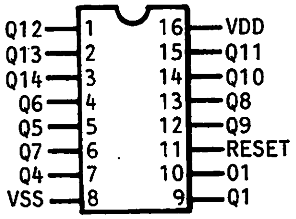
PIN CONFIGURATION


VREF A
VDD
DB0
DATA INPUTS
DB7
INPUT BUFFER
LATCH
DAC A
RFB A
OUT A
AGND
DAC A
DAC B
CS
WR
DGND
CONTROL LOGIC
LATCH
DAC B
RFB B
OUT B
VREF B

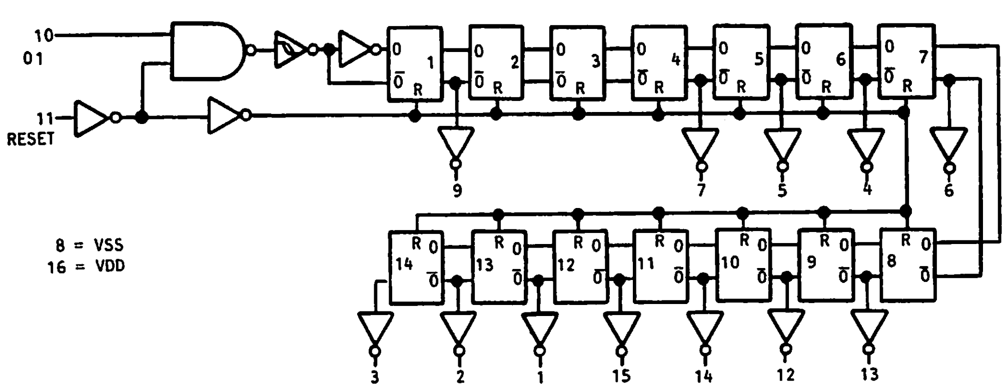
FUNCTIONAL DIAGRAM

FIGURE 6-10.

TYPE	IC NUMBER	LOCATION	REF. DES.
COUNTER	4020	CONTROL (A6)	U27
		P. CASSETTE PFC (A2)	U1


Q12 1
Q13 2
Q14 3
Q6 4
Q5 5
Q7 6
Q4 7
VSS 8
16 VDD
15 Q11
14 Q10
13 Q8
12 Q9
11 RESET
10 01
9 Q1

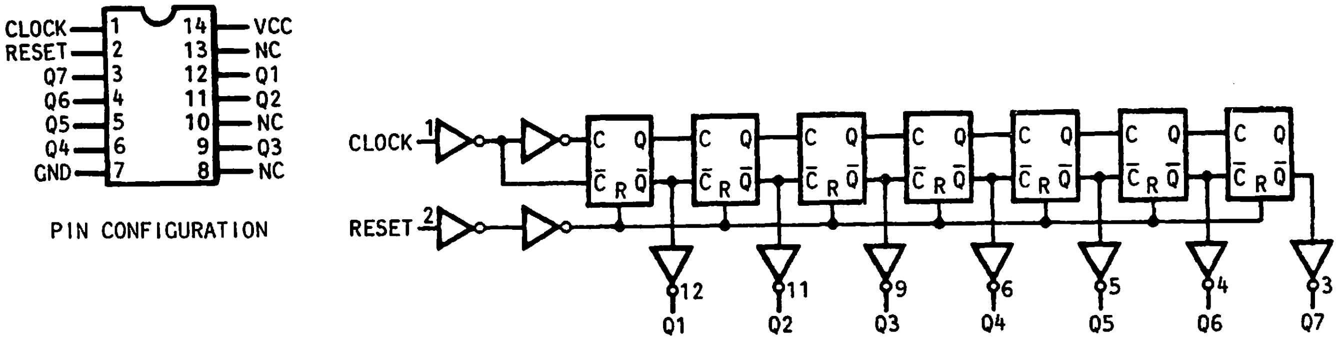
PIN CONFIGURATION


10
01
11
RESET
8 = VSS
16 = VDD
9
7
5
4
6
3
2
1
15
14
12
13

FUNCTIONAL DIAGRAM

FIGURE 6-11.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
COUNTER	4024	POWER SUPPLY (A2) Monitor	U23,U30

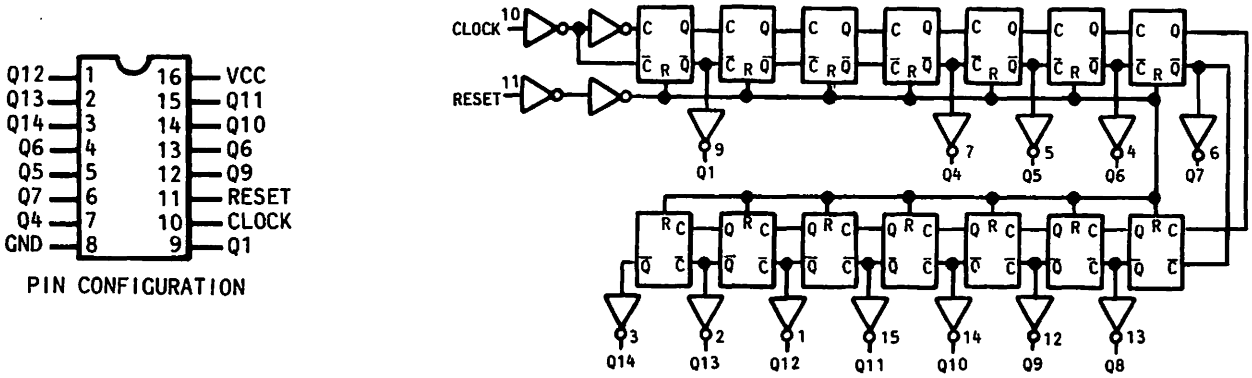

CLOCK 1
RESET 2
Q7 3
Q6 4
Q5 5
Q4 6
GND 7
14 VCC
13 NC
12 Q1
11 Q2
10 NC
9 Q3
8 NC
CLOCK 1
RESET 2
C Q
C̄ R Q̄
12 Q1
11 Q2
9 Q3
6 Q4
5 Q5
4 Q6
3 Q7

PIN CONFIGURATION

FUNCTIONAL DIAGRAM

FIGURE 6-12.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
COUNTER	74HC4020	GATEWAY (A5)	U13


Q12 1
Q13 2
Q14 3
Q6 4
Q5 5
Q7 6
Q4 7
GND 8
16 VCC
15 Q11
14 Q10
13 Q6
12 Q9
11 RESET
10 CLOCK
9 Q1
CLOCK 10
RESET 11
C Q
C̄ R Q̄
9 Q1
7 Q4
5 Q5
4 Q6
6 Q7
3 Q14
2 Q13
1 Q12
15 Q11
14 Q10
12 Q9
13 Q8

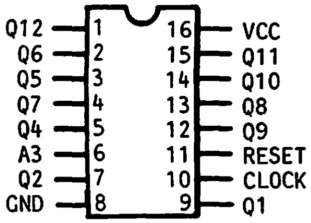
PIN CONFIGURATION

FUNCTIONAL DIAGRAM

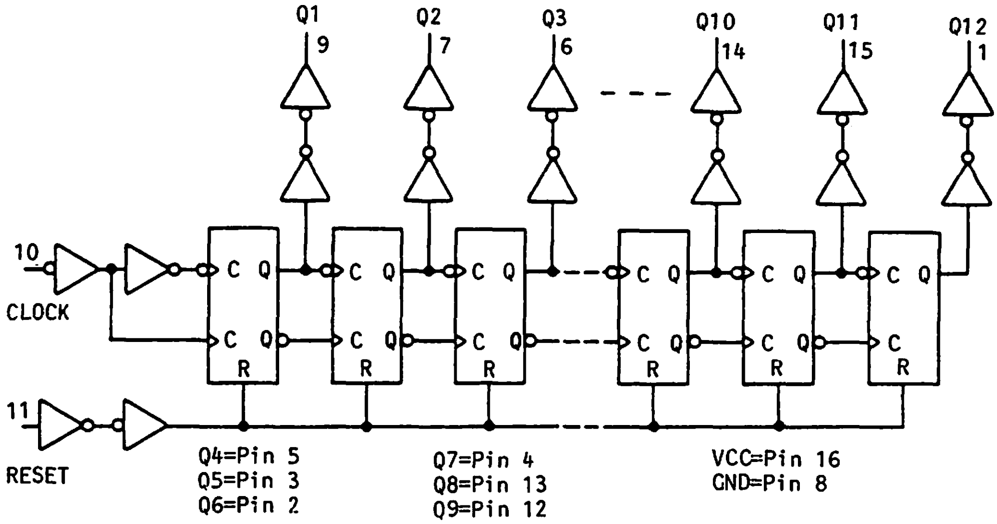
FIGURE 6-13.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
COUNTER	74HC4040	LOGIC (A8)	U22

ATTENTION


Q12
Q6
Q5
Q7
Q4
A3
Q2
GND
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
VCC
Q11
Q10
Q8
Q9
RESET
CLOCK
Q1

PIN CONFIGURATION

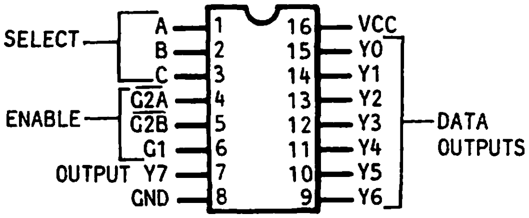

Q1
9
Q2
7
Q3
6
Q10
14
Q11
15
Q12
1
10
CLOCK
C Q
C Q
R
11
RESET
Q4=Pin 5
Q5=Pin 3
Q6=Pin 2
Q7=Pin 4
Q8=Pin 13
Q9=Pin 12
VCC=Pin 16
GND=Pin 8

FUNCTIONAL DIAGRAM

FIGURE 6-14.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
DECODER	74HC138	CONTROL (A6)	U2,U8
		GATEWAY (A5)	U8

ATTENTION


SELECT
A
B
C
ENABLE
G2A
G2B
G1
OUTPUT Y7
GND
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
VCC
Y0
Y1
Y2
Y3
Y4
Y5
Y6
DATA OUTPUTS

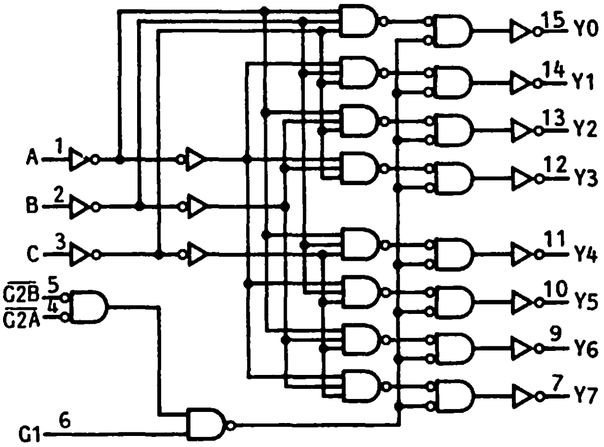
PIN CONFIGURATION

INPUTS					OUTPUTS							
ENABLE		SELECT										
G1	$\overline{G2}$*	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

*$\overline{G2} = \overline{G2A} + \overline{G2B}$

H = HIGH LEVEL, L = LOW LEVEL, X = DON'T CARE

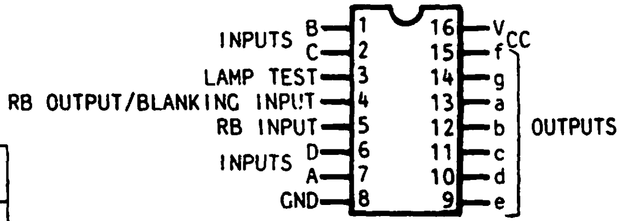
FUNCTION TABLE


15
Y0
14
Y1
13
Y2
12
Y3
11
Y4
10
Y5
9
Y6
7
Y7
A
1
B
2
C
3
G2B
5
4
G2A
G1
6

FUNCTIONAL DIAGRAM

FIGURE 6-15.

TYPE	IC NUMBER	LOCATION	REF. DES.
DECODER	74C48	LOWER SWITCH MODULE (A7)	U1


INPUTS B 1
INPUTS C 2
LAMP TEST 3
RB OUTPUT/BLANKING INPUT 4
RB INPUT 5
INPUTS D 6
INPUTS A 7
GND 8
16 VCC
15 f
14 g
13 a
12 b
11 c
10 d
9 e
OUTPUTS

PIN CONFIGURATION

DECIMAL OR FUNCTION	INPUTS LT	RBI	D	C	B	A	B1/RBO*	OUTPUTS a	b	c	d	e	f	g	NOTE
0	H	H	L	L	L	L	H	H	H	H	H	H	H	L	1
1	H	X	L	L	L	H	H	L	H	H	L	L	L	L	1
2	H	X	L	L	H	L	H	H	H	L	H	H	L	H	
3	H	X	L	L	H	H	H	H	H	H	H	L	L	H	
4	H	X	L	H	L	L	H	L	H	H	L	L	H	H	
5	H	X	L	H	L	H	H	H	L	H	H	L	H	H	
6	H	X	L	H	H	L	H	L	L	H	H	H	H	H	
7	H	X	L	H	H	H	H	H	H	H	L	L	L	L	
8	H	X	H	L	L	L	H	H	H	H	H	H	H	H	
9	H	X	H	L	L	H	H	H	H	H	L	L	H	H	
10	H	X	H	L	H	L	H	L	L	L	H	H	L	H	
11	H	X	H	L	H	H	H	L	L	H	H	L	L	H	
12	H	X	H	H	L	L	H	L	H	L	L	L	H	H	
13	H	X	H	H	L	H	H	H	L	L	H	L	H	H	
14	H	X	H	H	H	L	H	L	L	L	H	H	H	H	
15	H	X	H	H	H	H	H	L	L	L	L	L	L	L	
B1	X	X	X	X	X	X	L	L	L	L	L	L	L	L	2
RB1	H	L	L	L	L	L	L	L	L	L	L	L	L	L	3
LT	L	X	X	X	X	X	H	H	H	H	H	H	H	H	4

H = HIGH LEVEL, L = LOW LEVEL, X = IRRELEVANT

NOTE 1: The blanking input (B1) must be open when output functions 0-15 are desired. The ripple-blanking input (RB1) must be high, if blanking of a decimal zero is not desired.

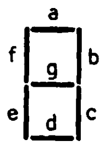
NOTE 2: When a low logic level is applied directly to the blanking input (B1), all segment outputs are low regardless of the level of any other input.

NOTE 3: When ripple-blanking input (RB1) and inputs A, B, C, and D are at a low level with the lamp-test input high, all segment outputs go low and the ripple-blanking output (RBO) goes to a low level (response condition).

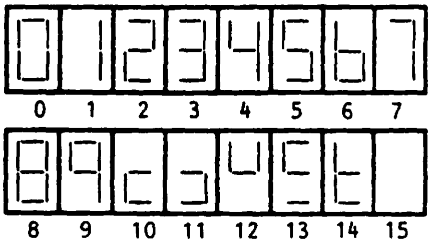
NOTE 4: When the blanking input/ripple-blanking output (B1/RBO) is open and a low is applied to the lamp-test input, all segment outputs are high.

* One B1/RBO is wire AND logic service as blanking input (B1) and/or ripple-blanking output (RBO).

FUNCTION TABLE



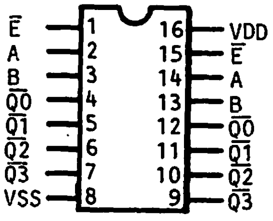
SEGMENT IDENTIFICATION


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

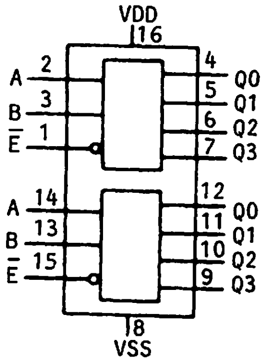
NUMERICAL DESIGNATIONS

FIGURE 6-16.

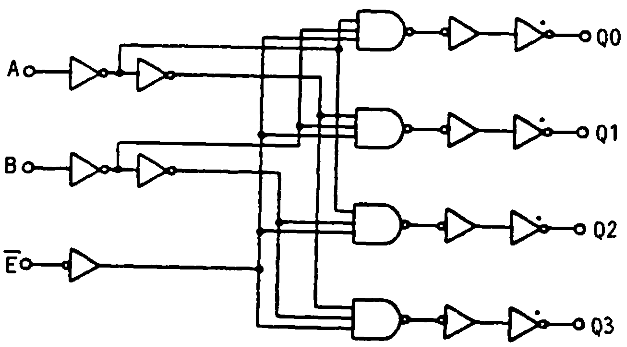
TYPE	IC NUMBER	LOCATION	REF. DES.
DECODER/ DEMULTIPLEXER	4555	LOGIC (A8)	U8


$\overline{E}$ 1
A 2
B 3
$\overline{Q0}$ 4
$\overline{Q1}$ 5
$\overline{Q2}$ 6
$\overline{Q3}$ 7
VSS 8
16 VDD
15 $\overline{E}$
14 A
13 B
12 $\overline{Q0}$
11 $\overline{Q1}$
10 $\overline{Q2}$
9 $\overline{Q3}$

PIN CONFIGURATION


VDD
16
A 2
B 3
$\overline{E}$ 1
4 Q0
5 Q1
6 Q2
7 Q3
A 14
B 13
$\overline{E}$ 15
12 Q0
11 Q1
10 Q2
9 Q3
8
VSS

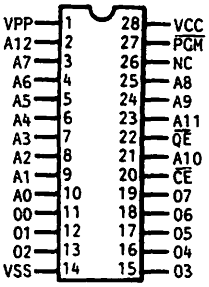
CONNECTION DIAGRAM


A
B
$\overline{E}$
Q0
Q1
Q2
Q3

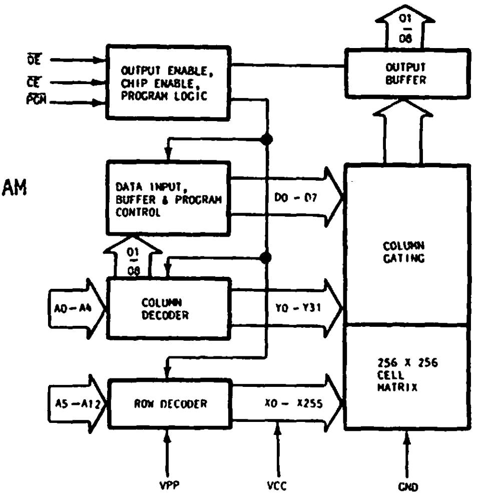
FUNCTIONAL DIAGRAM

FIGURE 6-17.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
EPROM	27C64	CONTROL (A6)	U15
		GATEWAY (A5)	U4


VPP 1 — 28 VCC
A12 2 — 27 $\overline{PGM}$
A7 3 — 26 NC
A6 4 — 25 A8
A5 5 — 24 A9
A4 6 — 23 A11
A3 7 — 22 $\overline{OE}$
A2 8 — 21 A10
A1 9 — 20 $\overline{CE}$
A0 10 — 19 07
00 11 — 18 06
01 12 — 17 05
02 13 — 16 04
VSS 14 — 15 03

PIN CONFIGURATION


$\overline{OE}$
$\overline{CE}$
$\overline{PGM}$
OUTPUT ENABLE, CHIP ENABLE, PROGRAM LOGIC
O1 – O8
OUTPUT BUFFER
DATA INPUT, BUFFER & PROGRAM CONTROL
D0 - D7
COLUMN GATING
O1 – O8
A0 – A4
COLUMN DECODER
Y0 - Y31
256 X 256 CELL MATRIX
A5 – A12
ROW DECODER
X0 – X255
VPP
VCC
GND

BLOCK DIAGRAM

FUNCTION TABLE

FUNCTION (PIN NO.) / MODE	ADDRESS INPUT (2-10,21,23-25)	DATA I/O (11-13,15-19)	$\overline{CE}$ (20)	$\overline{OE}$ (22)	$\overline{PGM}$ (27)	Icc SUPPLY (28)	Vpp (1)
READ	Ain	Dout	Vil	Vil	Vih	Icc1	Vcc
OUTPUT DISABLE	Ain	High Z	Vil	Vih Don't Care	Don't Care Vil	Icc1	Vcc
STAND BY	Don't Care	High Z	Vih	Don't Care	Don't Care	Isb1	Vcc
PROGRAM	Ain	Din	Vil	Don't Care	Vil	Icc1	Vpp
PROGRAM VERIFY	Ain	Dout	Vil	Vil	Vih	Icc1	Vpp
PROGRAM INHIBIT	Don't Care	High Z	Vih	Don't Care	Don't Care	Isb1	Vpp

(VCC (28) = +5, VSS (14) = GND)

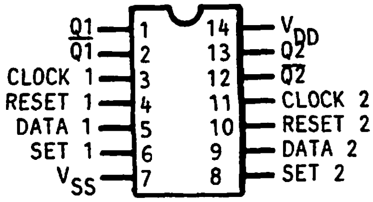
FIGURE 6-18.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, D TYPE	4013B	LOGIC (A8)	U32
		MAIN (A1)	U19
		POWER SUPPLY (A2) Monitor	U2

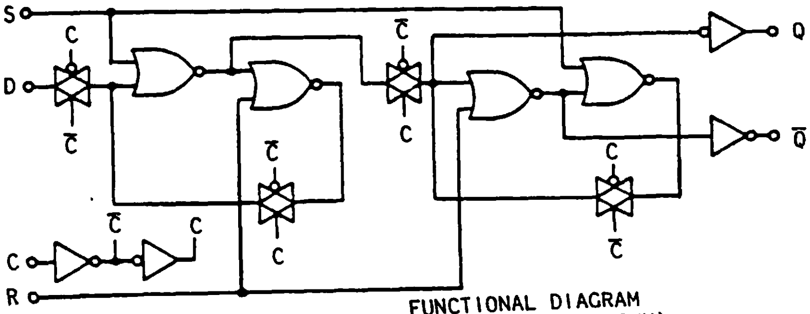
INPUTS				OUTPUTS		
CLOCK*	DATA	RESET	SET	Q	$\overline{Q}$	
↑	0	0	0	0	1	
↑	1	0	0	1	0	
↓	X	0	0	Q	$\overline{Q}$	No Change
X	X	1	0	0	1	
X	X	0	1	1	0	
X	X	1	1	1	1	

X = Don't Care
* = Level Change

FUNCTION TABLE


$\overline{Q1}$ 1 — 14 V_{DD}
$\overline{Q1}$ 2 — 13 Q2
CLOCK 1 3 — 12 $\overline{Q2}$
RESET 1 4 — 11 CLOCK 2
DATA 1 5 — 10 RESET 2
SET 1 6 — 9 DATA 2
V_{SS} 7 — 8 SET 2

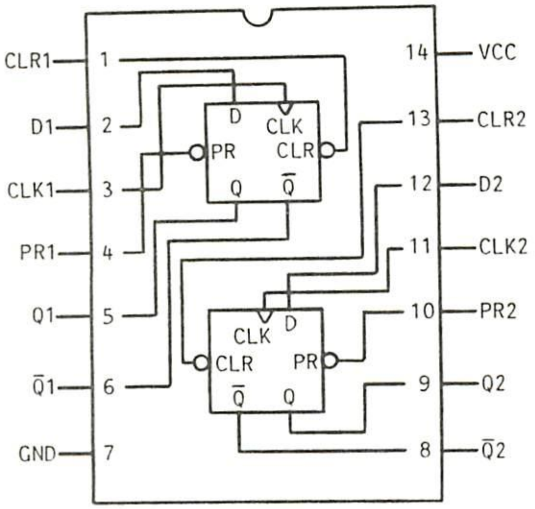
PIN CONFIGURATION


S
D
C
$\overline{C}$
$\overline{C}$
C
$\overline{C}$
C
C
$\overline{C}$
$\overline{C}$
C
Q
$\overline{Q}$
R

FUNCTIONAL DIAGRAM
(1/2 OF DEVICE SHOWN)

FIGURE 6-19.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, D TYPE W/RESET AND CLEAR ATTENTION	74HC74	POWER SUPPLY (A2) Monitor	U27


CLR1 1
D1 2
CLK1 3
PR1 4
Q1 5
$\overline{Q}$1 6
GND 7
14 VCC
13 CLR2
12 D2
11 CLK2
10 PR2
9 Q2
8 $\overline{Q}$2
D
CLK
PR
CLR
Q
$\overline{Q}$
CLK
D
CLR
PR
$\overline{Q}$
Q

CONNECTION DIAGRAM

INPUTS				OUTPUTS	
PR	CLR	CLK	D	Q	Q
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H*	H*
H	H	1	H	H	L
H	H	1	L	L	H
H	H	L	X	Q0	Q0

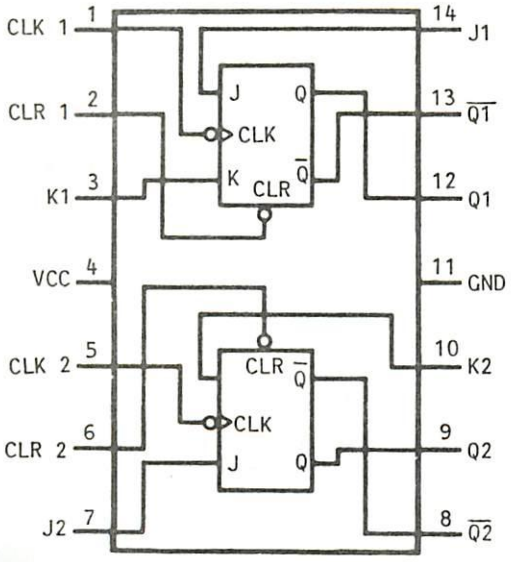
H = High level
L = Low level
X = Irrelevant
Q0 = The level of Q before the indicated steady-state input conditions were established.

*This configuration is nonstable; that is, it will not persist when preset and clear inputs return to their inactive (high) level.

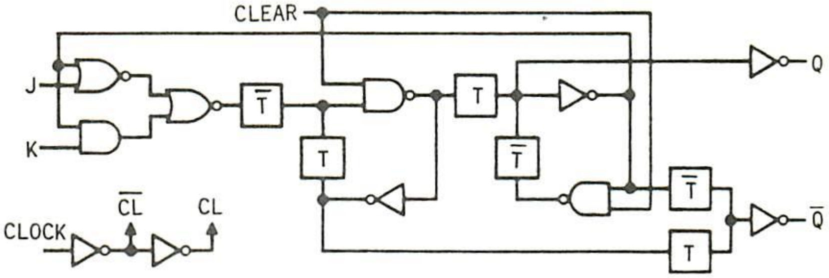
FUNCTION TABLE

FIGURE 6-20.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, J-K ATTENTION	74HC73	CONTROL (A6)	U9


CLK 1 1
CLR 1 2
K1 3
VCC 4
CLK 2 5
CLR 2 6
J2 7
14 J1
13 $\overline{Q1}$
12 Q1
11 GND
10 K2
9 Q2
8 $\overline{Q2}$
J
Q
CLK
K
CLR
$\overline{Q}$
CLR
$\overline{Q}$
CLK
J
Q

CONNECTION DIAGRAM


CLEAR
J
K
$\overline{T}$
T
T
T
$\overline{T}$
$\overline{T}$
T
Q
$\overline{Q}$
CLOCK
$\overline{CL}$
CL

FUNCTIONAL DIAGRAM

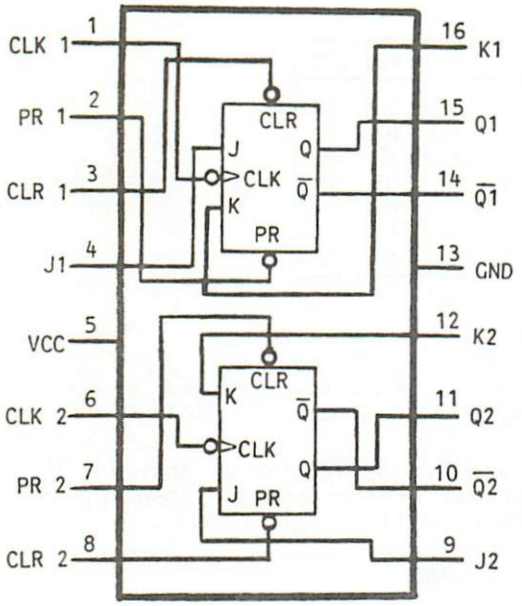
INPUTS				OUTPUTS	
CLR	CLK	J	K	Q	$\overline{Q}$
L	X	X	X	L	H
H	↓	L	L	Q0	$\overline{Q0}$
H	↓	H	L	H	L
H	↓	L	H	L	H
H	↓	H	H	*TOGGLE*	
H	H	X	X	Q0	$\overline{Q0}$

FUNCTION TABLE

FIGURE 6-21.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, J-K	74HC76	GATEWAY (A5)	U18

ATTENTION


CLK 1
1
PR 1
2
CLR 1
3
J1
4
VCC
5
CLK 2
6
PR 2
7
CLR 2
8
16
K1
15
Q1
14
$\overline{\text{Q1}}$
13
GND
12
K2
11
Q2
10
$\overline{\text{Q2}}$
9
J2
CLR
J
Q
CLK
$\overline{\text{Q}}$
K
PR
CLR
K
$\overline{\text{Q}}$
CLK
Q
J
PR

CONNECTION DIAGRAM

INPUTS					OUTPUTS	
PR	CLR	CLK	J	L	Q	$\overline{\text{Q}}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	L*	L*
H	H	↓	L	L	Q0	$\overline{\text{Q0}}$
H	H	↓	H	L	H	L
H	H	↓	L	H	L	H
H	H	↓	H	H	TOGGLE	
H	H	H	X	X	Q0	$\overline{\text{Q0}}$

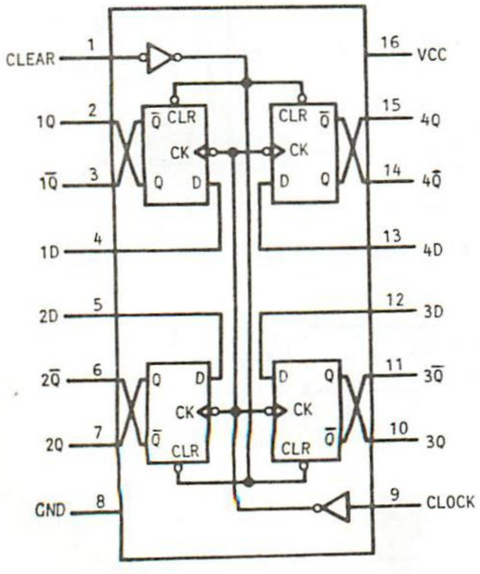
*This is an unstable condition, and is not guaranteed

FUNCTION TABLE

FIGURE 6-22.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, D TYPE	74HC175	CONTROL (A6)	U31

ATTENTION


CLEAR
1
1Q
2
$\overline{\text{1Q}}$
3
1D
4
2D
5
$\overline{\text{2Q}}$
6
2Q
7
GND
8
16
VCC
15
4Q
14
$\overline{\text{4Q}}$
13
4D
12
3D
11
$\overline{\text{3Q}}$
10
3Q
9
CLOCK
$\overline{\text{Q}}$ CLR
CK
Q D
CLR $\overline{\text{Q}}$
CK
D Q
Q D
CK
$\overline{\text{Q}}$ CLR
D Q
CK
CLR $\overline{\text{Q}}$

CONNECTION DIAGRAM

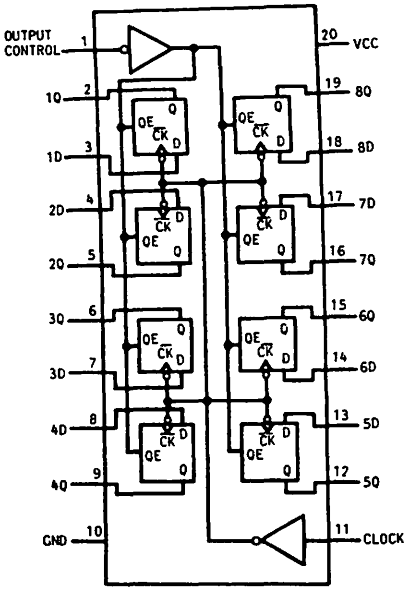
INPUTS			OUTPUTS	
CLEAR	CLOCK	D	Q	$\overline{\text{Q}}$
L	X	X	L	H
H	↑	H	H	L
H	↑	L	L	H
H	L	X	Q0	$\overline{\text{Q0}}$

H = HIGH LEVEL (STEADY STATE)
L = LOW LEVEL (STEADY STATE)
X = IRRELEVANT
↑ = TRANSITION FROM LOW TO HIGH LEVEL
Q0 = THE LEVEL OF Q BEFORE THE INDICATED STEADY STATE INPUT CONDITIONS WERE ESTABLISHED.

FUNCTION TABLE

FIGURE 6-23.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
FLIP-FLOP, D TYPE	74HC374	CONTROL (A6)	U17,U31,U35,U61
		RECORDER (A9)	U6



OUTPUT CONTROL 1
1Q 2
1D 3
2D 4
2Q 5
3Q 6
3D 7
4D 8
4Q 9
GND 10
20 VCC
19 8Q
18 8D
17 7D
16 7Q
15 6Q
14 6D
13 5D
12 5Q
11 CLOCK
OE
CK
D
Q

CONNECTION DIAGRAM

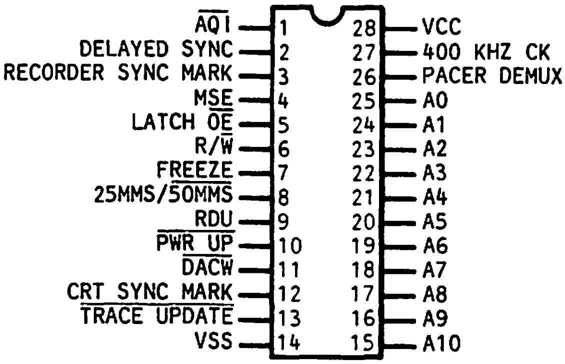
OUTPUT CONTROL	CLOCK	DATA	OUTPUT
L	↑	H	H
L	↑	L	L
L	L	X	Q0
H	X	X	Z

H = HIGH LEVEL
L = LOW LEVEL
↑ = TRANSITION FROM LOW-TO-HIGH
Z = HIGH IMPEDANCE STATE
Q0= THE LEVEL OF THE OUTPUT BEFORE STEADY STATE INPUT CONDITIONS WERE ESTABLISHED

FUNCTION TABLE

FIGURE 6-24.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
GATE ARRAY, NO FADE	(Custom IC)	CONTROL (A6)	U58

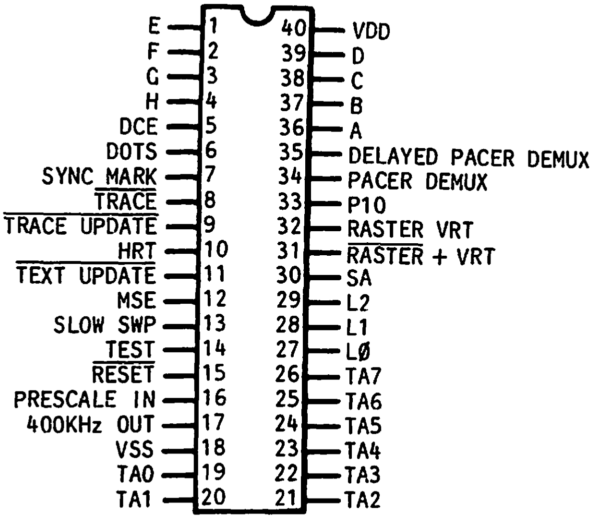


AQI 1
DELAYED SYNC 2
RECORDER SYNC MARK 3
MSE 4
LATCH OE 5
R/W 6
FREEZE 7
25MMS/50MMS 8
RDU 9
PWR UP 10
DACW 11
CRT SYNC MARK 12
TRACE UPDATE 13
VSS 14
28 VCC
27 400 KHZ CK
26 PACER DEMUX
25 A0
24 A1
23 A2
22 A3
21 A4
20 A5
19 A6
18 A7
17 A8
16 A9
15 A10

PIN CONFIGURATION

FIGURE 6-25.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
GATE ARRAY, RASTER CONTROLLER	(Custom IC)	CONTROL (A6)	U49

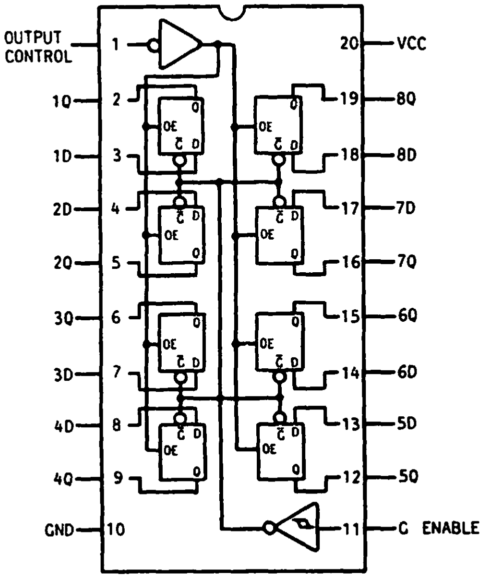


E 1
F 2
G 3
H 4
DCE 5
DOTS 6
SYNC MARK 7
TRACE 8
TRACE UPDATE 9
HRT 10
TEXT UPDATE 11
MSE 12
SLOW SWP 13
TEST 14
RESET 15
PRESCALE IN 16
400KHz OUT 17
VSS 18
TA0 19
TA1 20
40 VDD
39 D
38 C
37 B
36 A
35 DELAYED PACER DEMUX
34 PACER DEMUX
33 P10
32 RASTER VRT
31 RASTER + VRT
30 SA
29 L2
28 L1
27 L0
26 TA7
25 TA6
24 TA5
23 TA4
22 TA3
21 TA2

PIN CONFIGURATION

FIGURE 6-26.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
LATCH	74HC373	CONTROL (A6)	U16,U18
		GATEWAY (A5)	U6



OUTPUT CONTROL 1
1Q 2
1D 3
2D 4
2Q 5
3Q 6
3D 7
4D 8
4Q 9
GND 10
20 VCC
19 8Q
18 8D
17 7D
16 7Q
15 6Q
14 6D
13 5D
12 5Q
11 C ENABLE
OE
C
D
Q

CONNECTION DIAGRAM

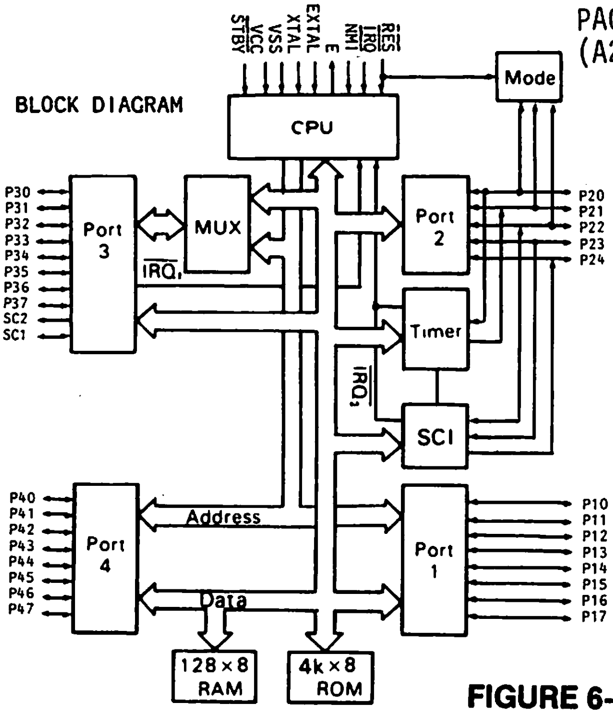
OUTPUT CONTROL	ENABLE G	D	OUTPUT Q
L	H	H	H
L	H	L	L
L	L	X	Q0
H	X	X	Z

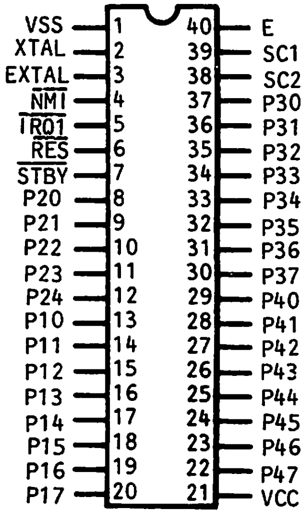
H = High level
L = Low level
X = Irrelevant
Q0 = The level of the output before steady-state input conditions were established.

FUNCTION TABLE

FIGURE 6-27.

TYPE	IC NUMBER	LOCATION	REF. DES.
MICROPROCESSOR ATTENTION	6301	ECG (A4)	U19
		LOGIC (A8)	U1,U18
		PACING CASSETTE PFC (A2)	U9

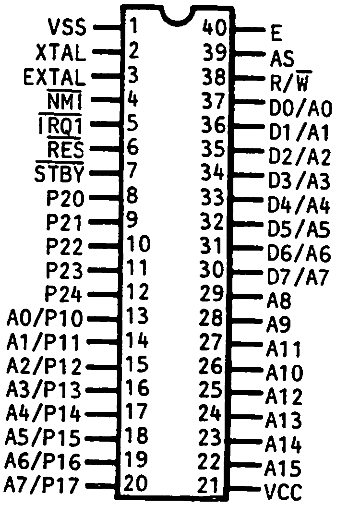

BLOCK DIAGRAM
STBY
VCC
VSS
XTAL
EXTAL
E
NMI
IRQ1
RES
Mode
CPU
P30
P31
P32
P33
P34
P35
P36
P37
SC2
SC1
Port 3
MUX
IRQ1
Port 2
P20
P21
P22
P23
P24
Timer
IRQ1
SCI
P40
P41
P42
P43
P44
P45
P46
P47
Port 4
Address
Data
Port 1
P10
P11
P12
P13
P14
P15
P16
P17
128×8 RAM
4k×8 ROM


VSS 1
XTAL 2
EXTAL 3
NMI 4
IRQ1 5
RES 6
STBY 7
P20 8
P21 9
P22 10
P23 11
P24 12
P10 13
P11 14
P12 15
P13 16
P14 17
P15 18
P16 19
P17 20
40 E
39 SC1
38 SC2
37 P30
36 P31
35 P32
34 P33
33 P34
32 P35
31 P36
30 P37
29 P40
28 P41
27 P42
26 P43
25 P44
24 P45
23 P46
22 P47
21 VCC

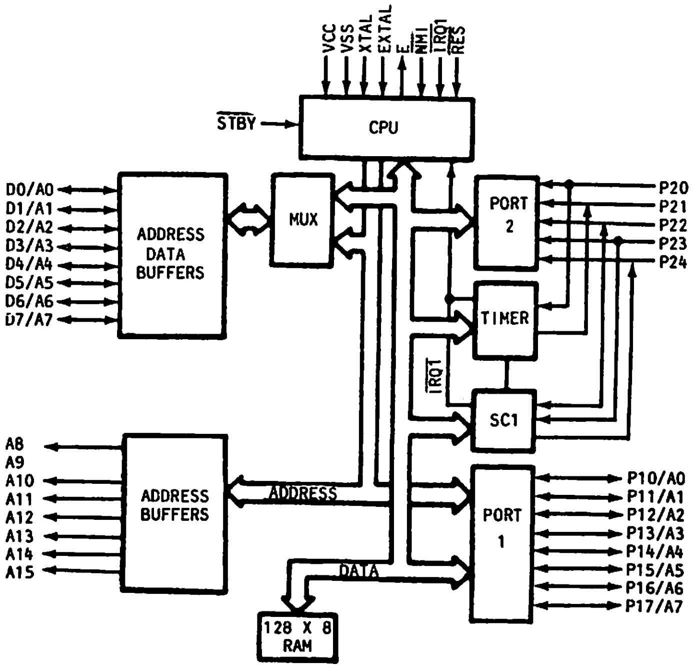
PIN CONFIGURATION

FIGURE 6-28.

TYPE	IC NUMBER	LOCATION	REF. DES.
MICROPROCESSOR ATTENTION	6303	CONTROL (A6)	U6
		GATEWAY (A5)	U1


VSS 1
XTAL 2
EXTAL 3
NMI 4
IRQ1 5
RES 6
STBY 7
P20 8
P21 9
P22 10
P23 11
P24 12
A0/P10 13
A1/P11 14
A2/P12 15
A3/P13 16
A4/P14 17
A5/P15 18
A6/P16 19
A7/P17 20
40 E
39 AS
38 R/W
37 D0/A0
36 D1/A1
35 D2/A2
34 D3/A3
33 D4/A4
32 D5/A5
31 D6/A6
30 D7/A7
29 A8
28 A9
27 A11
26 A10
25 A12
24 A13
23 A14
22 A15
21 VCC

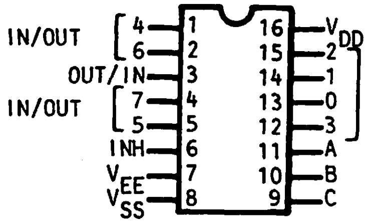
PIN CONFIGURATION


VCC
VSS
XTAL
EXTAL
E
NMI
IRQ1
RES
STBY
CPU
D0/A0
D1/A1
D2/A2
D3/A3
D4/A4
D5/A5
D6/A6
D7/A7
ADDRESS DATA BUFFERS
MUX
PORT 2
P20
P21
P22
P23
P24
TIMER
IRQ1
SCI
A8
A9
A10
A11
A12
A13
A14
A15
ADDRESS BUFFERS
ADDRESS
DATA
PORT 1
P10/A0
P11/A1
P12/A2
P13/A3
P14/A4
P15/A5
P16/A6
P17/A7
128 X 8 RAM

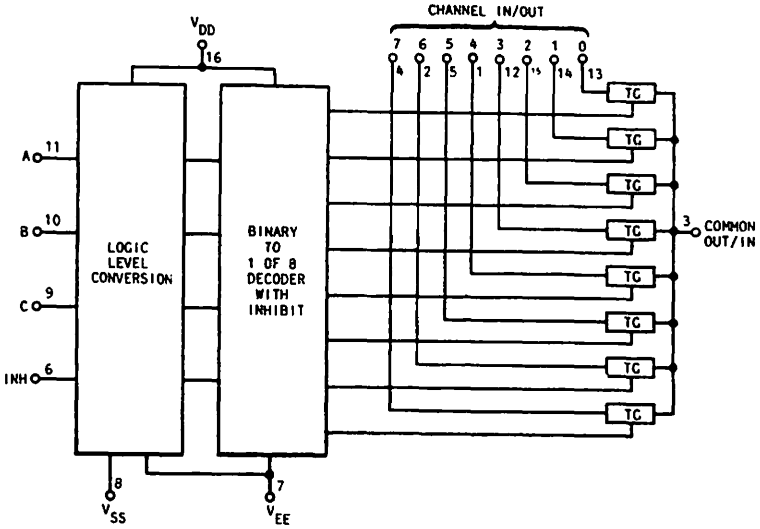
BLOCK DIAGRAM

FIGURE 6-29.

TYPE	IC NUMBER	LOCATION	REF. DES.
MULTIPLEXER/ DEMULTIPLEXER	4051BE	LOGIC (A8)	U24


IN/OUT
4
6
OUT/IN
IN/OUT
7
5
INH
V_EE
V_SS
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
V_DD
2
1
0
3
A
B
C
IN/OUT

PIN CONFIGURATION


V_DD
16
CHANNEL IN/OUT
7 6 5 4 3 2 1 0
4 2 5 1 12 15 14 13
A 11
B 10
C 9
INH 6
LOGIC LEVEL CONVERSION
BINARY TO 1 OF 8 DECODER WITH INHIBIT
TC
3
COMMON OUT/IN
8
V_SS
7
V_EE

BLOCK DIAGRAM

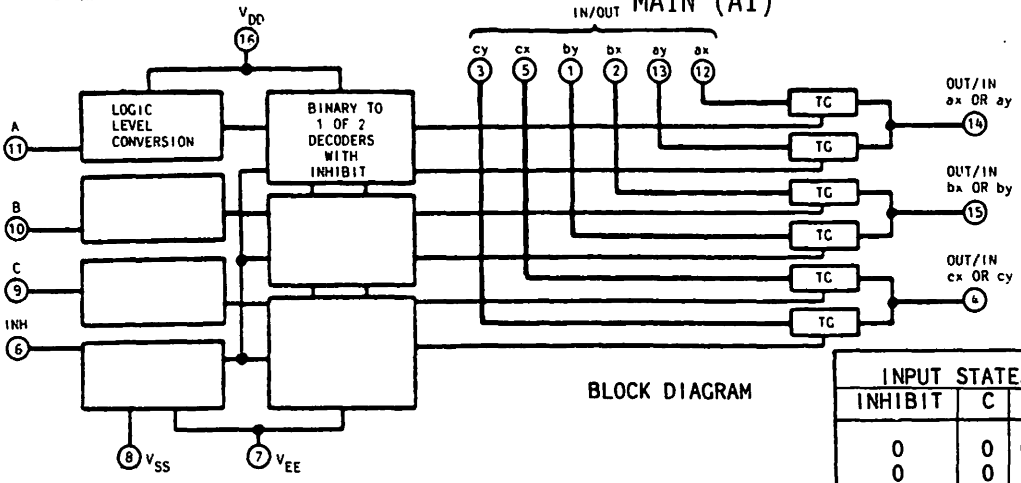
INPUT STATES				"ON" CHANNEL(S)
INHIBIT	C	B	A	
0	0	0	0	0
0	0	0	0	1
0	0	1	1	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	X	X	X	NONE

X = DON'T CARE

FUNCTION TABLE

FIGURE 6-30.

TYPE	IC NUMBER	LOCATION	REF. DES.
MULTIPLEXER/ DEMULTIPLEXER	4053BCN	CONTROL (A6)	U1,U36
		CRT (A7)	U2
		MAIN (A1)	U13,U23

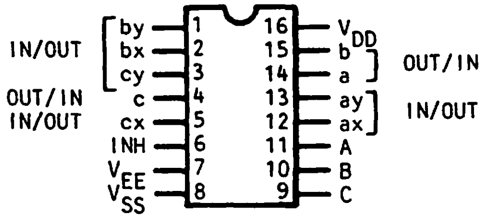

V_DD
16
IN/OUT
cy cx by bx ay ax
3 5 1 2 13 12
A 11
B 10
C 9
INH 6
LOGIC LEVEL CONVERSION
BINARY TO 1 OF 2 DECODERS WITH INHIBIT
TC
OUT/IN ax OR ay
14
OUT/IN bx OR by
15
OUT/IN cx OR cy
4
8 V_SS
7 V_EE

BLOCK DIAGRAM

INPUT STATES				"ON" CHANNEL(S)
INHIBIT	C	B	A	CD4053B
0	0	0	0	cx,bx,ax
0	0	0	1	cx,bx,ay
0	0	1	0	cx,by,ax
0	0	1	1	cx,by,ay
0	1	0	0	cy,bx,ax
0	1	0	1	cy,bx,ay
0	1	1	0	cy,by,ax
0	1	1	1	cy,by,ay
1	*	*	*	NONE

*Don't Care condition

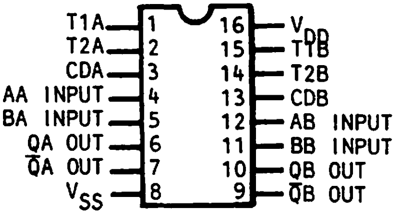
FUNCTION TABLE


IN/OUT
by
bx
cy
OUT/IN
c
IN/OUT
cx
INH
V_EE
V_SS
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9
V_DD
b
a
ay
ax
A
B
C
OUT/IN
IN/OUT

PIN CONFIGURATION

FIGURE 6-31.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
MULTIVIBRATOR, MONOSTABLE	4538B	LOGIC (A8)	U7

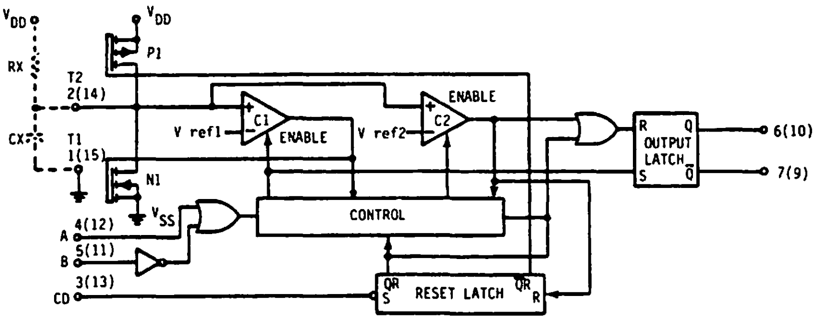

T1A 1
T2A 2
CDA 3
AA INPUT 4
BA INPUT 5
QA OUT 6
Q̄A OUT 7
VSS 8
16 VDD
15 T1B
14 T2B
13 CDB
12 AB INPUT
11 BB INPUT
10 QB OUT
9 Q̄B OUT

PIN CONFIGURATION

INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⎍	⊔
H	↑	H	⎍	⊔

H = HIGH level
L = LOW level
↑ = Transistion from LOW to HIGH
↓ = Transistion from HIGH to LOW
⎍ = One HIGH level pulse
⊔ = One LOW level pulse
X = Irrelevant

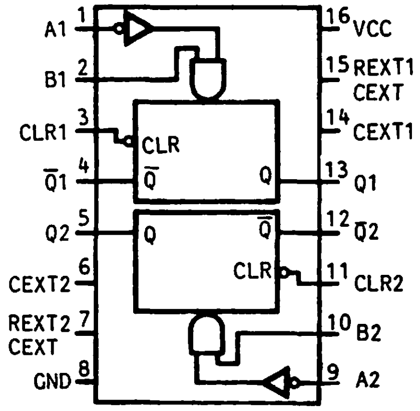
FUNCTION TABLE


VDD
VDD
P1
RX
T2
2(14)
CX
T1
1(15)
N1
VSS
4(12)
A
5(11)
B
3(13)
CD
C1
V ref1
ENABLE
V ref2
C2
ENABLE
CONTROL
R Q
OUTPUT LATCH
S Q̄
6(10)
7(9)
QR
S
RESET LATCH
Q̄R
R

FUNCTIONAL DIAGRAM
(1/2 OF DEVICE SHOWN)

FIGURE 6-32.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
MULTIVIBRATOR, MONOSTABLE	74HC221	POWER SUPPLY (A2) Monitor	U28,U29
		RECORDER (A9)	U11


A1 1
B1 2
CLR1 3
Q̄1 4
Q2 5
CEXT2 6
REXT2 CEXT 7
GND 8
16 VCC
15 REXT1 CEXT
14 CEXT1
13 Q1
12 Q̄2
11 CLR2
10 B2
9 A2
CLR
Q̄
Q
Q
Q̄
CLR

CONNECTION DIAGRAM

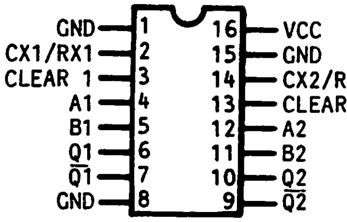
INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⎍	⊔
H	↓	H	⎍	⊔
↑	L	H	⎍	⊔

H = HIGH LEVEL
L = LOW LEVEL
↑ = TRANSITION FROM LOW TO HIGH
↓ = TRANSITION FROM HIGH TO LOW
⎍ = ONE HIGH LEVEL PULSE
⊔ = ONE LOW LEVEL PULSE
X = IRRELEVANT

FUNCTION TABLE

FIGURE 6-33.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
MULTIVIBRATOR, MONOSTABLE	74HC4538	PACING CASSETTE PFC (A2)	U13

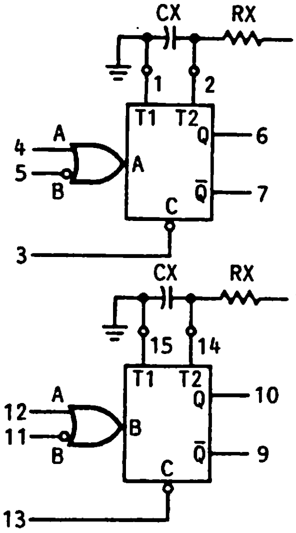

GND 1
CX1/RX1 2
CLEAR 1 3
A1 4
B1 5
Q1 6
$\overline{Q1}$ 7
GND 8
16 VCC
15 GND
14 CX2/RX2
13 CLEAR 2
12 A2
11 B2
10 Q2
9 $\overline{Q2}$

PIN CONFIGURATION

INPUTS			OUTPUTS	
CLR	A	B	Q	$\overline{Q}$
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↓	⊓	⊔
H	↑	H	⊓	⊔

FUNCTION TABLE

H=High Level
L=Low Level
↑=Transistion from Low to High
↓=Transition from High to Low
⊓=One High Level Pulse
⊔=One Low Level Pulse
X=Irrelevant

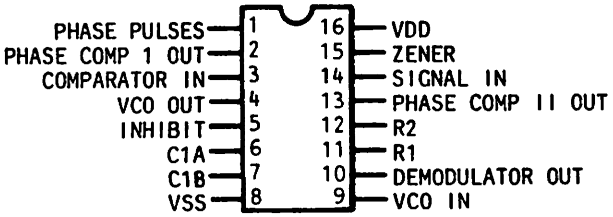

CX
RX
VDD
1
2
T1 T2
Q
6
$\overline{Q}$
7
4
5
A
B
A
C
3
CX
RX
VDD
15
14
T1 T2
Q
10
$\overline{Q}$
9
12
11
A
B
B
C
13

RX AND CS ARE EXTERNAL COMPONENTS

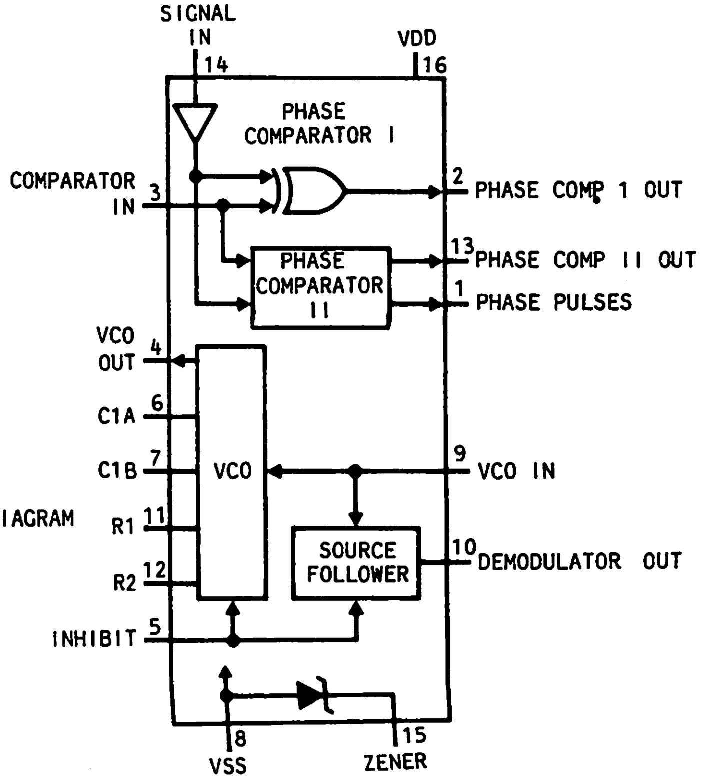
FUNCTIONAL DIAGRAM

FIGURE 6-34.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
PHASE LOCKED LOOP	4046	ECG (A4)	U34
		MAIN (A1)	U3,U18


PHASE PULSES 1
PHASE COMP 1 OUT 2
COMPARATOR IN 3
VCO OUT 4
INHIBIT 5
C1A 6
C1B 7
VSS 8
16 VDD
15 ZENER
14 SIGNAL IN
13 PHASE COMP II OUT
12 R2
11 R1
10 DEMODULATOR OUT
9 VCO IN

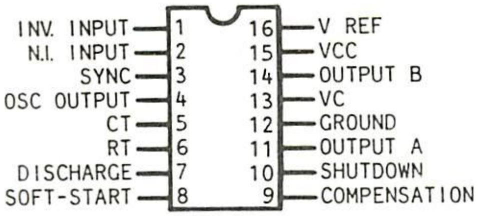
PIN CONFIGURATION


SIGNAL IN
14
VDD
16
PHASE COMPARATOR I
COMPARATOR IN
3
2
PHASE COMP 1 OUT
13
PHASE COMP II OUT
1
PHASE PULSES
PHASE COMPARATOR II
VCO OUT
4
C1A
6
C1B
7
VCO
9
VCO IN
R1
11
R2
12
SOURCE FOLLOWER
10
DEMODULATOR OUT
INHIBIT
5
8
VSS
15
ZENER

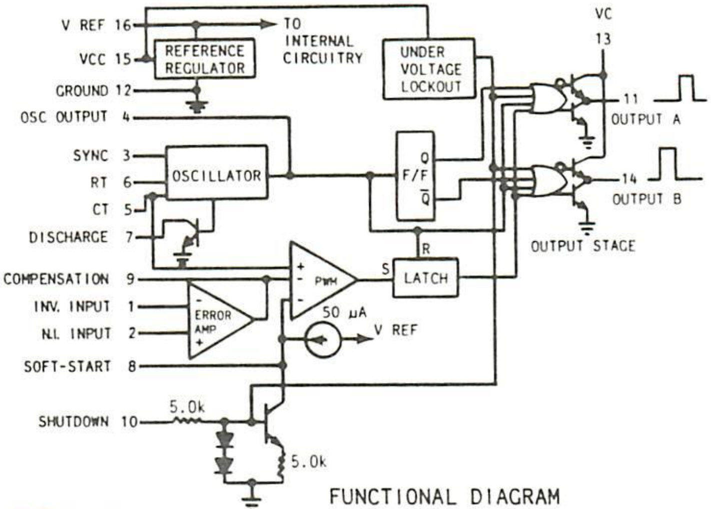
CONNECTION DIAGRAM

FIGURE 6-35.

TYPE	IC NUMBER	LOCATION	REF. DES.
PULSE WIDTH MODULATOR	3525	CHARGER (A3)	U1
		ECG (A4)	U6
		POWER SUPPLY (A2) Defibrillator	U1
		P. CASSETTE PFC (A2)	U11


INV. INPUT 1
N.I. INPUT 2
SYNC 3
OSC OUTPUT 4
CT 5
RT 6
DISCHARGE 7
SOFT-START 8
16 V REF
15 VCC
14 OUTPUT B
13 VC
12 GROUND
11 OUTPUT A
10 SHUTDOWN
9 COMPENSATION

PIN CONFIGURATION

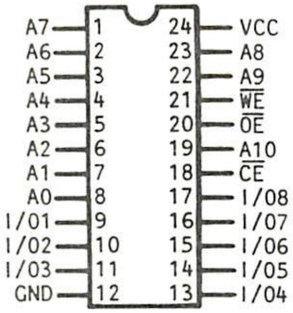

V REF 16
VCC 15
GROUND 12
OSC OUTPUT 4
SYNC 3
RT 6
CT 5
DISCHARGE 7
COMPENSATION 9
INV. INPUT 1
N.I. INPUT 2
SOFT-START 8
SHUTDOWN 10
REFERENCE REGULATOR
TO INTERNAL CIRCUITRY
UNDER VOLTAGE LOCKOUT
OSCILLATOR
F/F
Q
Q̄
PWM
LATCH
S
R
ERROR AMP
50 µA
V REF
5.0k
5.0k
VC
13
11
OUTPUT A
14
OUTPUT B
OUTPUT STAGE

FUNCTIONAL DIAGRAM

FIGURE 6-36.

TYPE	IC NUMBER	LOCATION	REF. DES.
RAM, STATIC 2K X 8	UP446-2C	CONTROL (A6)	U47,U63,U64

ATTENTION

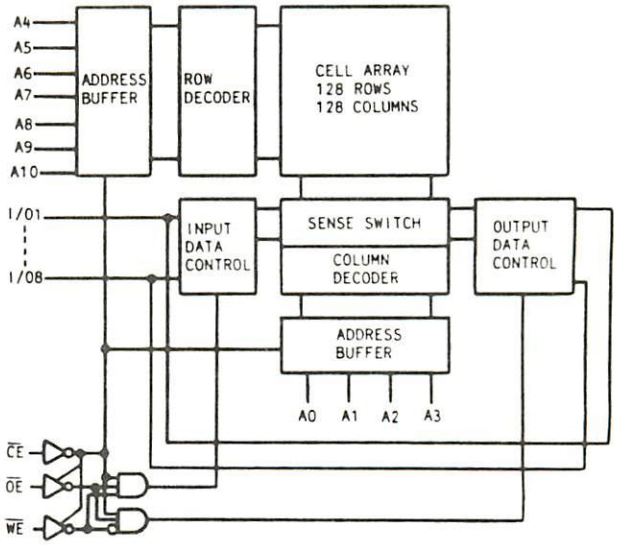

A7 1
A6 2
A5 3
A4 4
A3 5
A2 6
A1 7
A0 8
I/O1 9
I/O2 10
I/O3 11
GND 12
24 VCC
23 A8
22 A9
21 W̄Ē
20 ŌĒ
19 A10
18 C̄Ē
17 I/O8
16 I/O7
15 I/O6
14 I/O5
13 I/O4

PIN CONFIGURATION

$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	MODE	I/O	ICCURR
H	X	X	Not Selected	HZ	Standby
L	H	H	Not Selected	HZ	Active
L	L	H	Read	D_{OUT}	Active
L	X	L	Write	D_{IN}	Active

H = High level
L = Low level
X = Irrelevant
HZ = High impedance output state

FUNCTION TABLE


A4
A5
A6
A7
A8
A9
A10
ADDRESS BUFFER
ROW DECODER
CELL ARRAY 128 ROWS 128 COLUMNS
I/O1
I/O8
INPUT DATA CONTROL
SENSE SWITCH
COLUMN DECODER
OUTPUT DATA CONTROL
ADDRESS BUFFER
A0
A1
A2
A3
C̄Ē
ŌĒ
W̄Ē

FUNCTIONAL DIAGRAM

FIGURE 6-37.

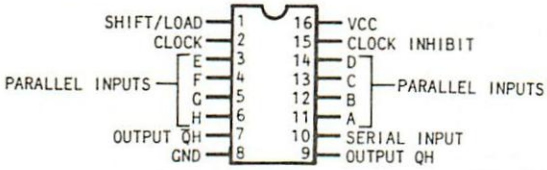
TYPE
REGISTER

IC NUMBER
74HC165

LOCATION
LOGIC (A8)

REF. DES.
U20,U21

ATTENTION

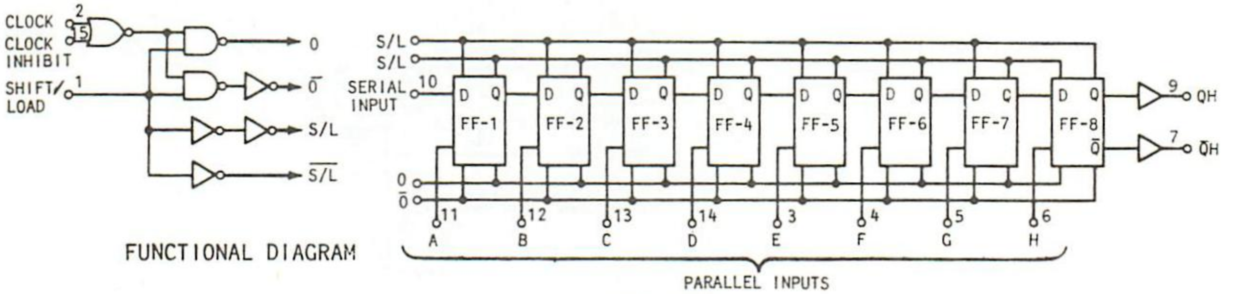

SHIFT/LOAD 1
CLOCK 2
E 3
F 4
G 5
H 6
PARALLEL INPUTS
OUTPUT Q̄H 7
GND 8
16 VCC
15 CLOCK INHIBIT
14 D
13 C
12 B
11 A
PARALLEL INPUTS
10 SERIAL INPUT
9 OUTPUT QH

PIN CONFIGURATION

FUNCTION TABLE

INPUTS					INTERNAL OUTPUTS		OUTPUT
SHIFT/ LOAD	CLOCK INHIBIT	CLOCK	SERIAL	PARALLEL A...H	QA	QB	QH
L	X	X	X	A...H	A	B	H
H	L	L	X	X	QA0	QB0	QH0
H	L	↑	H	X	H	QAN	QGN
H	L	↑	L	X	L	QAN	QGN
H	H	X	X	X	QA0	QB0	QH0

H = HIGH LEVEL (STEADY STATE), L = LOW LEVEL (STEADY STATE)
X = IRRELEVANT (ANY INPUT, INCLUDING TRANSITIONS)
↑ = TRANSITION FROM LOW TO HIGH LEVEL
QA0, QB0, QH0 = THE LEVEL OF QA, QB OR QH RESPECTIVELY, BEFORE INDICATED STEADY STATE CONDITIONS WERE ESTABLISHED.
QAN, QGN = THE LEVEL OF QA OR QG BEFORE MOST RECENT TRANSITION OF THE CLOCK; INDICATES A ONE-BIT SHIFT.


CLOCK 2
CLOCK INHIBIT 15
SHIFT/LOAD 1
0
0̄
S/L
S̄/L̄
S/L
S/L
SERIAL INPUT 10
D Q
FF-1
FF-2
FF-3
FF-4
FF-5
FF-6
FF-7
FF-8
Q̄
9 QH
7 Q̄H
0
0̄
11 A
12 B
13 C
14 D
3 E
4 F
5 G
6 H
PARALLEL INPUTS

FUNCTIONAL DIAGRAM

FIGURE 6-38.

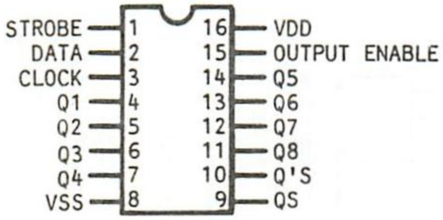
TYPE
REGISTER/LATCH

IC NUMBER
4094B

LOCATION
LOGIC (A8)

REF. DES.
U23

ATTENTION


STROBE 1
DATA 2
CLOCK 3
Q1 4
Q2 5
Q3 6
Q4 7
VSS 8
16 VDD
15 OUTPUT ENABLE
14 Q5
13 Q6
12 Q7
11 Q8
10 Q'S
9 QS

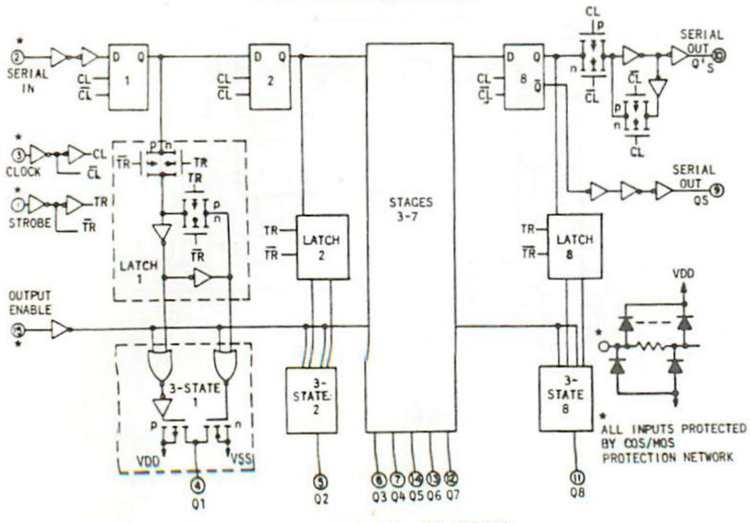
PIN CONFIGURATION

FUNCTION TABLE

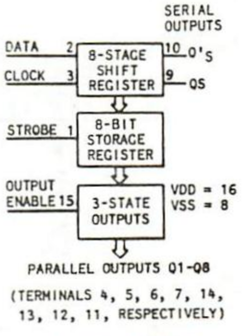
CLK	OUTPUT ENABLE	STROBE	DATA	PARALLEL OUTPUTS		SERIAL OUTPUTS	
				Q1	QN	QS*	Q'S
╱	0	X	X	OC	OC	Q7	NC
╲	0	X	X	OC	OC	NC	Q7
╱	1	0	X	NC	NC	Q7	NC
╱	1	1	0	0	QN1	Q7	NC
╱	1	1	1	1	QN1	Q7	NC
╲	1	1	1	NC	NC	NC	Q7

X = Don't Care
NC = No Change
OC = Open Circuit
Logic 1 = High
Logic 0 = Low

*At the positive clock edge information in the 7th shift register stage is transferred to the 8th register stage and the QS output.


*
② SERIAL IN
D Q
1
CL
C̄L̄
D Q
2
*
③ CLOCK
CL
C̄L̄
*
① STROBE
TR
T̄R̄
LATCH 1
OUTPUT ENABLE ⑮
*
3-STATE 1
VDD
VSS
④ Q1
TR
T̄R̄
LATCH 2
3-STATE 2
⑤ Q2
STAGES 3-7
⑥⑦⑭⑬⑫
Q3 Q4 Q5 Q6 Q7
D Q
8
Q̄
LATCH 8
3-STATE 8
⑪ Q8
CL
p
n
SERIAL OUT Q'S ⑩
SERIAL OUT QS ⑨
VDD
*
ALL INPUTS PROTECTED BY COS/MOS PROTECTION NETWORK

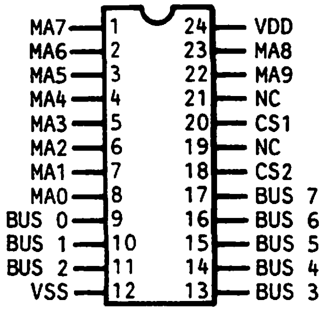
FUNCTIONAL DIAGRAM


SERIAL OUTPUTS
DATA 2
CLOCK 3
8-STAGE SHIFT REGISTER
10 Q'S
9 QS
STROBE 1
8-BIT STORAGE REGISTER
OUTPUT ENABLE 15
3-STATE OUTPUTS
VDD = 16
VSS = 8
PARALLEL OUTPUTS Q1-Q8
(TERMINALS 4, 5, 6, 7, 14, 13, 12, 11, RESPECTIVELY)

BLOCK DIAGRAM

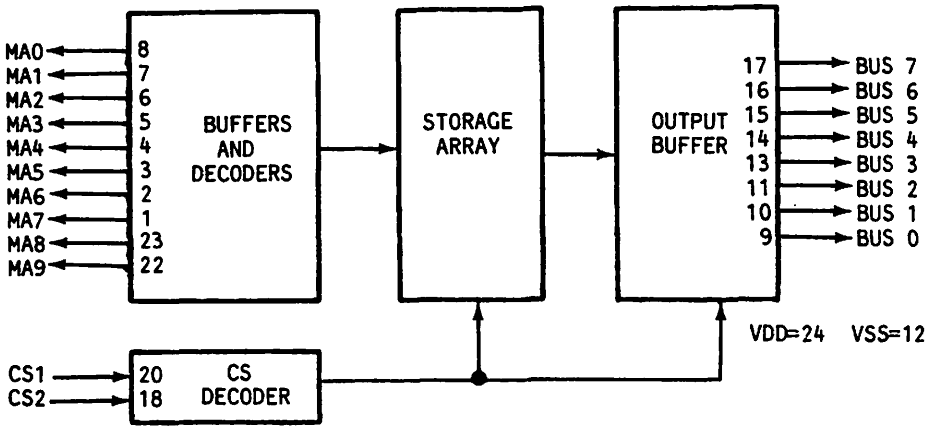
FIGURE 6-39.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
ROM ATTENTION	1834E	CONTROL (A6)	U50



MA7 1
MA6 2
MA5 3
MA4 4
MA3 5
MA2 6
MA1 7
MA0 8
BUS 0 9
BUS 1 10
BUS 2 11
VSS 12
24 VDD
23 MA8
22 MA9
21 NC
20 CS1
19 NC
18 CS2
17 BUS 7
16 BUS 6
15 BUS 5
14 BUS 4
13 BUS 3

PIN CONFIGURATION

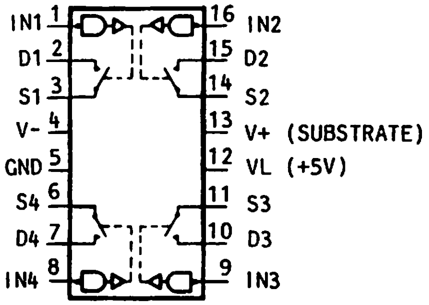


MA0 8
MA1 7
MA2 6
MA3 5
MA4 4
MA5 3
MA6 2
MA7 1
MA8 23
MA9 22
BUFFERS AND DECODERS
STORAGE ARRAY
OUTPUT BUFFER
17 BUS 7
16 BUS 6
15 BUS 5
14 BUS 4
13 BUS 3
11 BUS 2
10 BUS 1
9 BUS 0
VDD=24 VSS=12
CS1 20
CS2 18
CS DECODER

FUNCTIONAL DIAGRAM

FIGURE 6-40.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
SWITCH, ANALOG ATTENTION	211CJ	CONTROL (A6) ECG (A4)	U13,U23 U9



IN1 1
D1 2
S1 3
V- 4
GND 5
S4 6
D4 7
IN4 8
16 IN2
15 D2
14 S2
13 V+ (SUBSTRATE)
12 VL (+5V)
11 S3
10 D3
9 IN3

CONNECTION DIAGRAM

LOGIC	SWITCH
0	ON
1	OFF

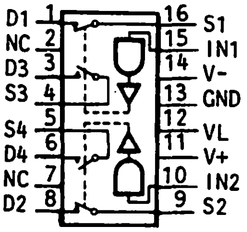
SWITCH OPEN FOR LOGIC "1" INPUT (POSITIVE LOGIC)

FUNCTION TABLE

FIGURE 6-41.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
SWITCH, ANALOG	243	RECORDER (A9)	U5

ATTENTION


D1 1
NC 2
D3 3
S3 4
S4 5
D4 6
NC 7
D2 8
16 S1
15 IN1
14 V-
13 GND
12 VL
11 V+
10 IN2
9 S2

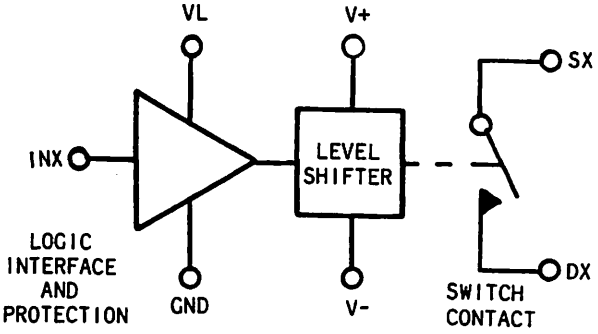
CONNECTION DIAGRAM

DUAL SPDT

IN LOGIC	SW1 SW2	SW3 SW4
0	OFF	ON
1	ON	OFF

ALL SWITCHES SHOWN IN THE LOGIC "1" SWITCH STATE

FUNCTION TABLE

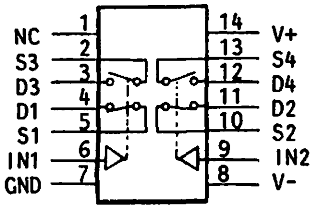

VL
V+
SX
INX
LEVEL SHIFTER
LOGIC INTERFACE AND PROTECTION
GND
V-
DX
SWITCH CONTACT

FUNCTIONAL DIAGRAM

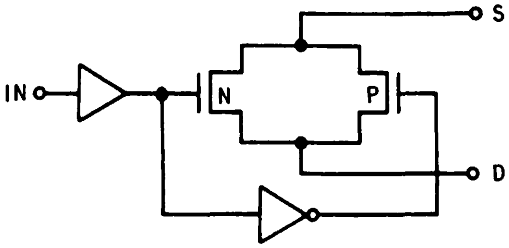
FIGURE 6-42.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
SWITCH, ANALOG, CMOS COMPATIBLE	307 *	ECG (A4)	U5
SWITCH, ANALOG, TTL COMPATIBLE	303 *	ECG (A4)	U4,U10,U14,U36

ATTENTION


NC 1
S3 2
D3 3
D1 4
S1 5
IN1 6
GND 7
14 V+
13 S4
12 D4
11 D2
10 S2
9 IN2
8 V-

PIN CONFIGURATION



FUNCTIONAL DIAGRAM

LOGIC	SW1 SW2	SW3 SW4
0	OFF	ON
1	ON	OFF

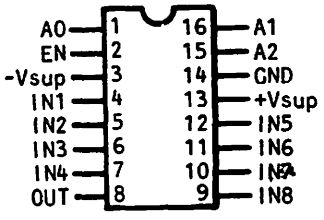
FUNCTION TABLE

*NOTE: THESE ICs HAVE IDENTICAL PIN CONFIGURATIONS
BUT ARE NOT INTERCHANGEABLE

FIGURE 6-43.

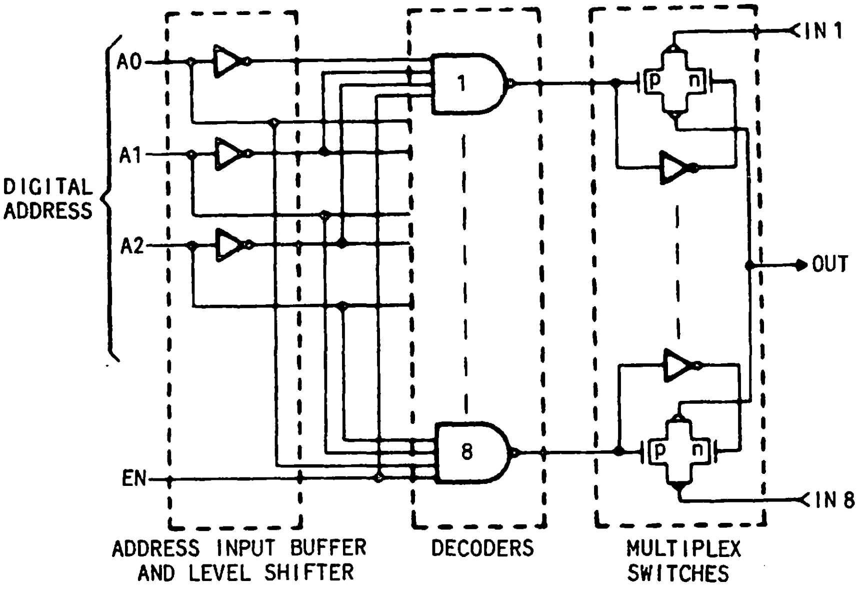
TYPE	IC NUMBER	LOCATION	REF. DES.
SWITCH, ANALOG	508A	ECG (A4)	U38-U40

ATTENTION


A0 1
EN 2
-Vsup 3
IN1 4
IN2 5
IN3 6
IN4 7
OUT 8
16 A1
15 A2
14 GND
13 +Vsup
12 IN5
11 IN6
10 IN7
9 IN8

PIN CONFIGURATION

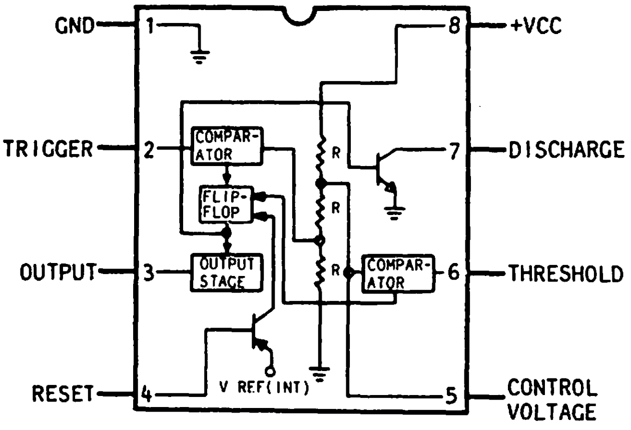
A2	A1	A0	EN	"ON" CHANNEL
X	X	X	L	NONE
L	L	L	H	1
L	L	H	H	2
L	H	L	H	3
L	H	H	H	4
H	L	L	H	5
H	L	H	H	6
H	H	L	H	7
H	H	H	H	8


A0
A1
A2
DIGITAL ADDRESS
EN
1
8
p
n
IN 1
IN 8
OUT
ADDRESS INPUT BUFFER AND LEVEL SHIFTER
DECODERS
MULTIPLEX SWITCHES

FUNCTIONAL DIAGRAM

FIGURE 6-44.

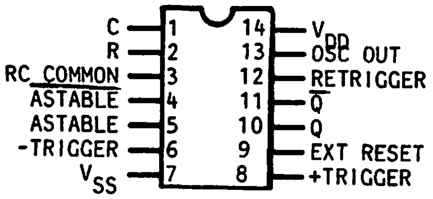
TYPE	IC NUMBER	LOCATION	REF. DES.
TIMER	555	ANODE SUPPLY (A8)	U2
		MAIN (A1)	U15


GND 1
TRIGGER 2
OUTPUT 3
RESET 4
8 +VCC
7 DISCHARGE
6 THRESHOLD
5 CONTROL VOLTAGE
COMPARATOR
FLIP-FLOP
OUTPUT STAGE
COMPARATOR
R
R
R
V REF(INT)

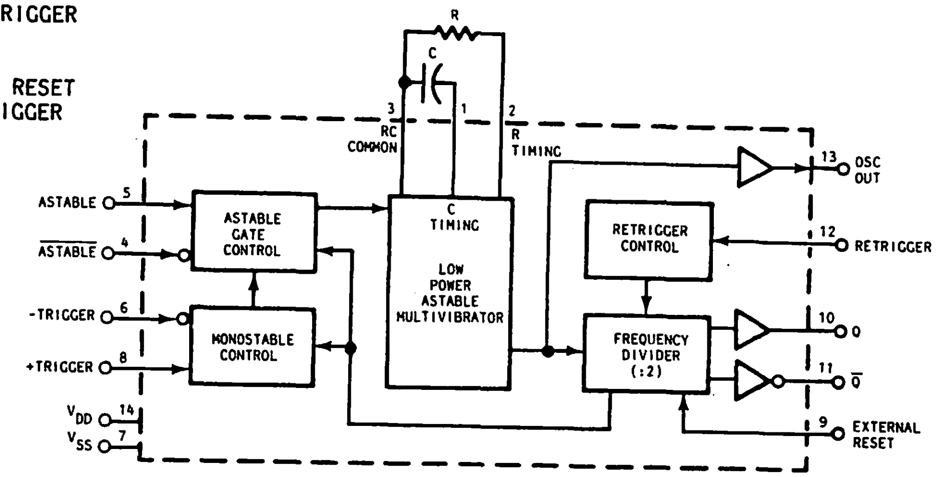
CONNECTION DIAGRAM

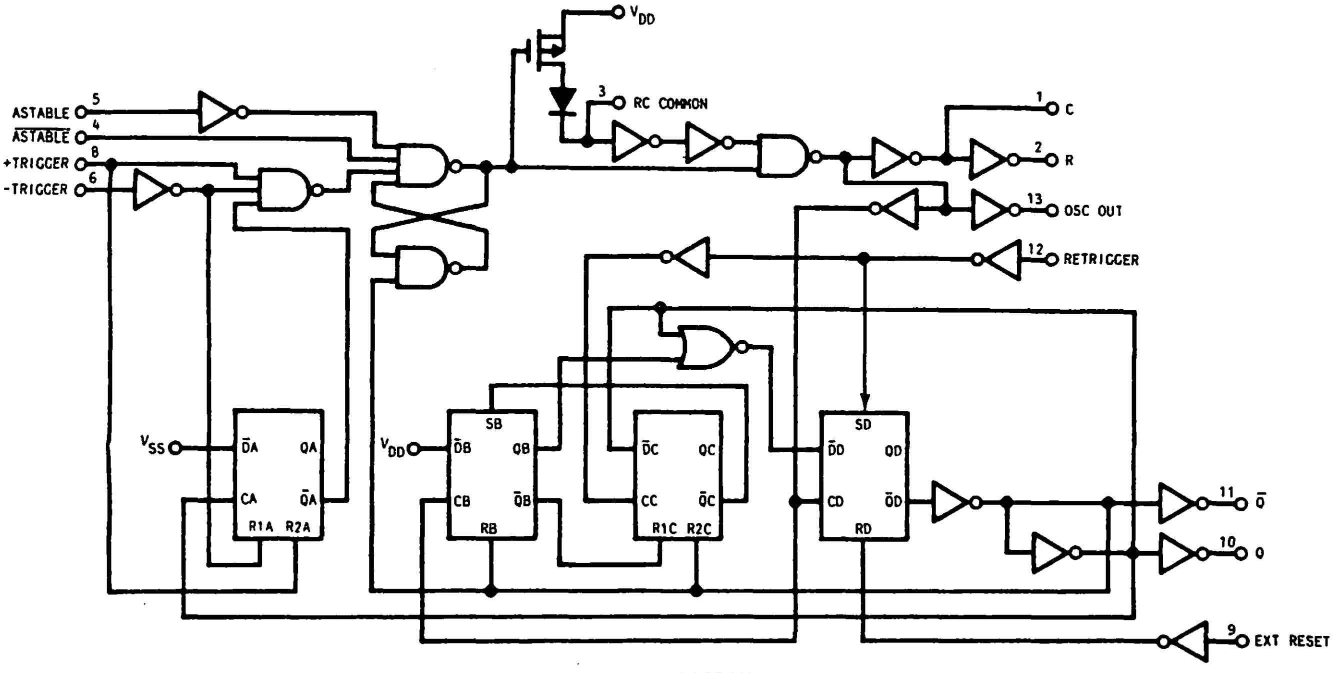
FIGURE 6-45.

TYPE	IC NUMBER	LOCATION	REF. DES.
TIMER ATTENTION	4047	POWER SUPPLY (A2) Monitor	U26,U102


C 1
R 2
RC COMMON 3
ASTABLE 4
ASTABLE 5
-TRIGGER 6
VSS 7
14 VDD
13 OSC OUT
12 RETRIGGER
11 Q̄
10 Q
9 EXT RESET
8 +TRIGGER

PIN CONFIGURATION

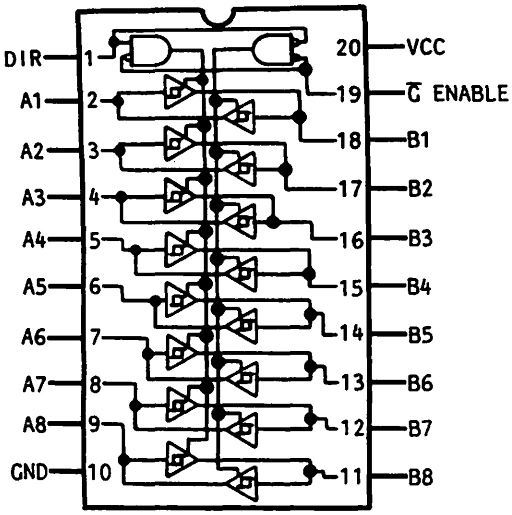

R
C
3 RC COMMON
1
2 R TIMING
ASTABLE 5
ASTABLE 4
-TRIGGER 6
+TRIGGER 8
VDD 14
VSS 7
ASTABLE GATE CONTROL
MONOSTABLE CONTROL
C TIMING
LOW POWER ASTABLE MULTIVIBRATOR
RETRIGGER CONTROL
FREQUENCY DIVIDER (:2)
13 OSC OUT
12 RETRIGGER
10 Q
11 Q̄
9 EXTERNAL RESET


VDD
ASTABLE 5
ASTABLE 4
+TRIGGER 8
-TRIGGER 6
3 RC COMMON
1 C
2 R
13 OSC OUT
12 RETRIGGER
VSS
D̄A QA
CA Q̄A
R1A R2A
VDD
SB
D̄B QB
CB Q̄B
RB
D̄C QC
CC Q̄C
R1C R2C
SD
D̄D QD
CD Q̄D
RD
11 Q̄
10 Q
9 EXT RESET

FUNCTIONAL DIAGRAM

FIGURE 6-46.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
TRANSCEIVER ATTENTION	74HC245	CONTROL (A6) GATEWAY (A5)	U4,U7,U19 U7



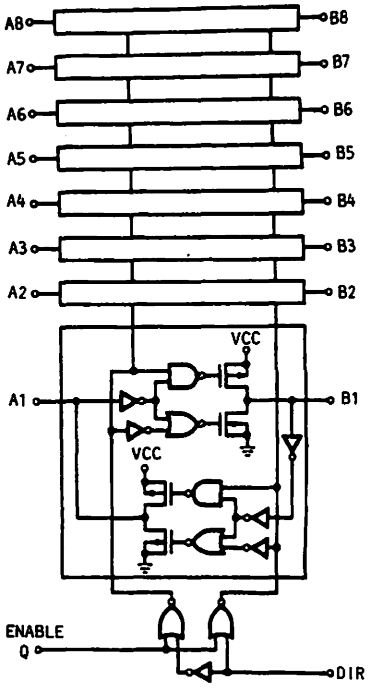
DIR
A1
A2
A3
A4
A5
A6
A7
A8
GND
1
2
3
4
5
6
7
8
9
10
20
19
18
17
16
15
14
13
12
11
VCC
$\overline{G}$ ENABLE
B1
B2
B3
B4
B5
B6
B7
B8

CONNECTION DIAGRAM

ENABLE $\overline{G}$	DIRECTION CONTROL DIR	OPERATION
L	L	B data to A bus
L	H	A data to B bus
H	X	Isolation

H = High level
L = Low level
X = Irrelevant

FUNCTION TABLE

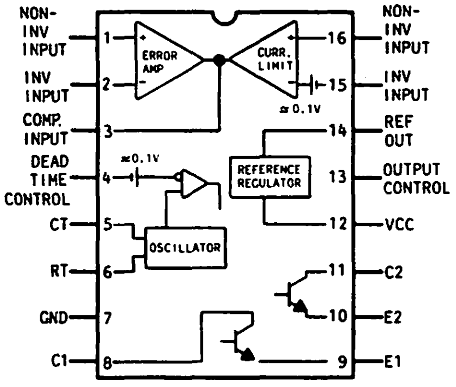


A8
A7
A6
A5
A4
A3
A2
A1
B8
B7
B6
B5
B4
B3
B2
B1
VCC
VCC
ENABLE
G
DIR

FUNCTIONAL DIAGRAM

FIGURE 6-47.

TYPE	**IC NUMBER**	**LOCATION**	**REF. DES.**
VOLTAGE REGULATOR, SWITCHING	TL494CN	MAIN (A1)	U11

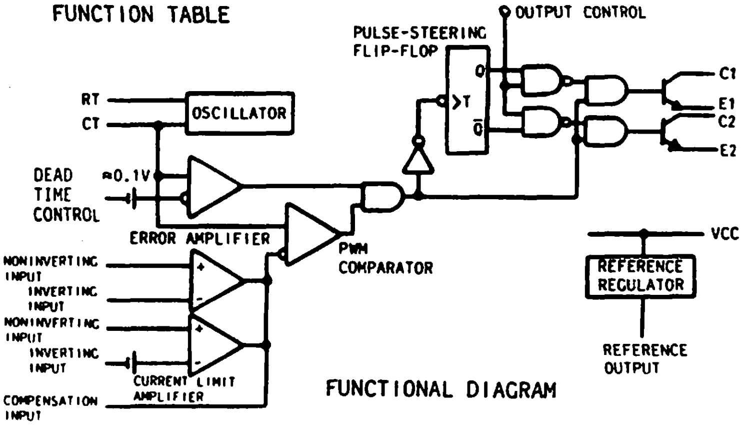


NON-INV INPUT
INV INPUT
COMP. INPUT
DEAD TIME CONTROL
CT
RT
GND
C1
1
2
3
4
5
6
7
8
ERROR AMP
CURR. LIMIT
≈0.1V
≈0.1V
REFERENCE REGULATOR
OSCILLATOR
16
15
14
13
12
11
10
9
NON-INV INPUT
INV INPUT
REF OUT
OUTPUT CONTROL
VCC
C2
E2
E1

CONNECTION DIAGRAM

PHYSIO DASH NO.	TEMPERATURE RANGE °C
-00	0 TO +70
-01	0 TO +70
-02	-25 TO +85
-03	-25 TO +85
-04	-55 TO +125

FUNCTION TABLE



OUTPUT CONTROL
PULSE-STEERING FLIP-FLOP
Q
>T
$\overline{Q}$
C1
E1
C2
E2
RT
CT
OSCILLATOR
DEAD TIME CONTROL
≈0.1V
ERROR AMPLIFIER
PWM COMPARATOR
NONINVERTING INPUT
INVERTING INPUT
NONINVERTING INPUT
INVERTING INPUT
CURRENT LIMIT AMPLIFIER
COMPENSATION INPUT
VCC
REFERENCE REGULATOR
REFERENCE OUTPUT

FUNCTIONAL DIAGRAM

FIGURE 6-48.